ELECTRICAL WORLD

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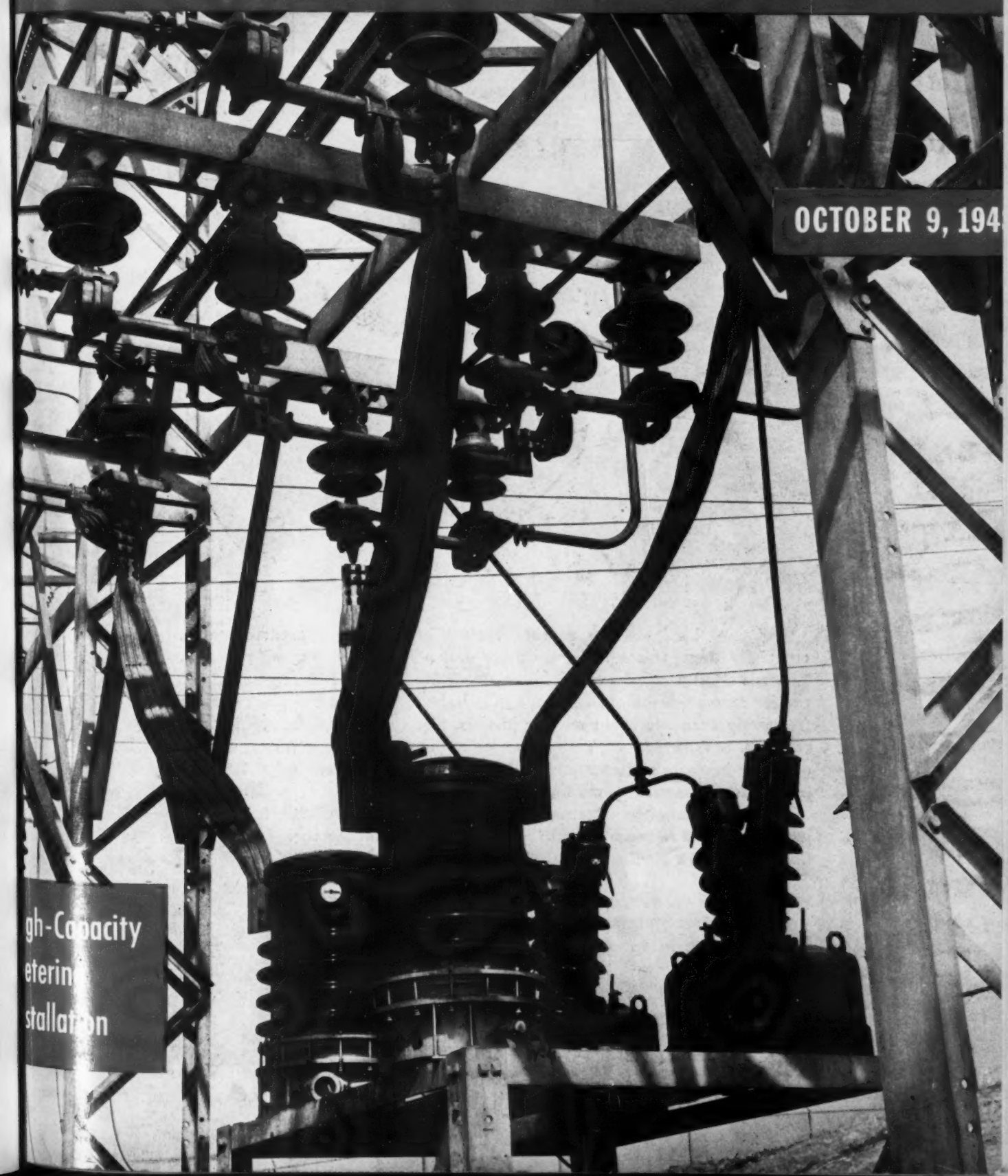

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ELECTRICAL WORLD

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October 9, 1948

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High-capacity metering unit links the utility's and customer's 25-kv bus. Its load terminals is ownership dividing line. Unit can be by-passed by airbreak switch (not shown) and isolated gang operated rotary type disconnect switches seen at top of picture. C.T.'s are 600-1,200/5 amp double ratio units

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COMING IN THE OCTOBER 23 ISSUE

Applying Transformers on Banked Secondary Systems
High Capacity from Steam Turbine with Five Stages of Blading Removed

WHEREVER THEY SERVE— LOOK FOR LONG LIFE

In today's many-sided industrial picture . . . with today's installation costs, only the longest-lived wires and cables are economical. Okonite wires and cables, built to stand up better and longer, offset high installation costs.

In realizing this goal, there are many "musts" for Okonite. Up-river fine Para rubber, for example, goes into Okonite cable insulations because it provides *all* needed factors. Okonite's strip insulating process is used because it assures perfect centering of conductors. Vulcanizing is done in a continuous metal mold so that every foot of cable gets uniform treatment — a practice that's standard only with Okonite.

In addition to a-c tests, Okonite subjects its cable to high voltage d-c tests more severe than used by any other cable manufacturer. Long time heat runs prove the stability of Okonite insulations. And these tests are checked not only by the accelerated-aging oxygen bomb, but by the slow, sure, year-after-year weather exposures made in Okonite's proving ground —a permanent outdoor cable laboratory. For detailed descriptions of Okonite "musts," write for your copy of illustrated 32-page Research Bulletin EW101. The Okonite Company, Passaic, New Jersey.

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Private Enterprise Feeding On Itself

REPRINTED BELOW, *as it appeared in the Bradenton, Fla., Herald on Sept. 19, 1948, is a story about a move toward municipal ownership of power in Bradenton. This news story makes its own point so well that we are merely reprinting it, rather than rewriting it and editorializing upon it.*

"Referendum Held Unnecessary

CITY POWER SYSTEM URGED BY FINANCIER

"Advocates of a municipally-owned electric plant and distribution system in Bradenton appear to be seeking action on this issue without resort to a referendum.

"The movement, about which little has been heard publicly in recent months, received fresh impetus at a dinner meeting held Friday evening at the Country Club.

"Ninety men were present, including Bradenton and Palmetto officials. John T. Campbell presided.

"The gathering heard Carleton D. Beh, investment banker from Des Moines, Iowa, declare that Florida laws were more than adequate for issuance of revenue certificates to buy or replace the electric utility, without a referendum; that a resolution by City Council was sufficient authority.

"Beh, president of a firm which has handled financing for more than 200 municipally-owned utilities in 20 states, was introduced by G. B. Knowles, who served as moderator during a subsequent discussion period.

"An aggressive speaker, Beh (pronounced 'Bay') pointed out that there is a fine line between handling municipal security business and becoming an evangelist for municipal ownership. He spoke on both sides of the line, reviewing experiences in the municipal security business and strongly urging that Bradenton get into the power business without delay.

"Bradenton was described by the speaker as an 'ideal-size' community for such an undertaking. He asserted that it 'couldn't lose.'

"Twenty-five years ago, Beh said, cities and towns were going through birth pangs of municipal water utilities, with private operators asserting their service couldn't be matched for dependability and quality. Today, he added, nearly 90 percent of all water used flows through municipally owned mains, with Birmingham the sole exception among major industrial cities.

"Citing a similar growth in the public-owned power systems, he said nearly 3,500 municipal light plants are serving communities ranging in size from Los Angeles down to a midwestern town of 300 population. He described the early stages of this development as difficult because it was necessary, first, to get adequate revenue bond laws in all states and, second, to secure interest rates the cities could afford to pay.

"The Securities and Exchange Commission, created early in the Roosevelt Administration, was credited with calling public attention to this field by revealing huge earnings of holding companies.

Recalls No Failures

"Beh declared that in helping finance more than 200 municipal electric utilities he knew of no record of failure, that none of the plants was for sale and that none of these communities would go back to private ownership, although he knew of many for which private concerns would pay a big price.

"The speaker said it was basically more sound that utilities should be owned and operated for the community than that they be operated for profit of a private company.

" 'You can't help but make a profit,' he as-

serted. 'You can kick it around, you can even steal part of it, and still have some left.'

"He also asserted that questions about the desirability of such an undertaking here should be answered 'by Bradenton people without inquiry to any foreign-owned corporation.'

"He reported that Springfield, Mo., went into the municipal power business after losing a large industry to Miami, Okla., which offered lower rates from its own plant. He declared that Springfield in three years had taken in almost two-thirds of the cost of its investment.

"Municipal power plants have long been established in Florida, he said, and all are making money.

"He recommended operation by an independent board of trustees if the project is undertaken in Bradenton. Three or five members should be enough for such a board, he said, adding that its terms should be staggered so that no council could affect the appointment of more than one.

Beh Is Available

"He also recommended that Bradenton produce as well as distribute its own utility, (sic) although the big profit is in the distribution end, so that the system would not have to haggle periodically over wholesale rates. He declared that it was easy to borrow for the entire operation, and said he was available to arrange financing if requested. 'You will need some technical advice,' he said, 'and that's our business.'

"He declared that citizens must be 'cagey about apathy—by inoculation by the power company or by neglect—that might postpone the decision 25 or 30 years.' This was brought out in opposition to a franchise to the existing system. (The Florida Power & Light Company franchise in Bradenton expired in 1933, or thereabouts, and was never renewed.)

"An active unit of 100 men could put such a project over, Beh said. He described it as 'the greatest single community service' because of its revenue possibilities. He declared that rates charged by a publicly-owned utility could be competitive and still provide substantial revenue for municipal operation, because city-owned plants did not have to pay huge federal excess profits taxes.

" 'It's a bonanza under city ownership and control,' he asserted, adding that such revenue would promote municipal growth in good times and provide insurance against 'tougher days ahead.'

" 'You've got to do collective community thinking for and in behalf of yourselves,' the speaker concluded.

Difference of Opinion

"Taking over as moderator, Knowles invited questions 'but not arguments.' Although no one undertook to discuss the case for private ownership, questions indicated some difference of opinion as well as a desire to get the financier's answers to counter-arguments. Questions included:

"What about the failure of public utility ventures in South Carolina? Beh said he did not know of any and asked for a specific case. When Sumter was mentioned, he said: 'Never heard of it, but I'll find out.'

"Could a city-owned utility get an adequate maintenance and repair force in the event of a hurricane? Beh thought it could, either from other cities or from the Federal Power Commission.

"What about provision for depreciation and replacement? Beh said it was a good idea on a limited basis, but that a municipal plant did not need a huge reserve as borrowing money was easier for a city than for a private concern.

Litigation Possible

"What about litigation by private interests to oppose public ownership? Beh said that might have to be faced, mentioning a 'knock-down and drag-out fight' at Springfield, Mo., and citing another Midwestern town that had been in and out of courts for 11 years, but kept its plant going. 'It may take quite a while,' he said.

"An informal check revealed that while a majority of the group at Friday's meeting were municipal ownership advocates, others had not made up their minds or had accepted invitations without a clear understanding as to the purpose."

NEWS OF THE ELECTRICAL WORLD

The Electrical Week

Utilities have always been generous in pensioning their employees. But a recent court decision has brought up a new angle. Unions are going to have something to say about the pensions . . . The Supreme Court goes back to work next week. Two utility cases coming up involve the Grand River Dam Authority and the Engineers Public Service Co. . . . The New York PSC has cleared the way for merger of the Niagara Hudson System . . . The Munitions Board has the Army Engineers studying the protection of hydro plants against bomb damage in future wars . . . Puget Sound P&L has sold the last of its "fringe" properties in Washington . . . And in the nation's capital, REA reported on farm electrification, and Administrator Wickard didn't miss the opportunity to cry "power shortage."

The CIO Utility Workers have made "Americanism" the theme of their third annual convention in Washington, Oct 15. It has been busy cleaning out the Commies from its leadership.

Hoover Commission planners of federal reorganization are discussing the desirability for a new, autonomous farm lending agency. It would absorb Rural Electrification Administration, Farm Credit Administration, other bureaus now in Agriculture Department.

AEC has finally cracked down on "left-wing" unions. GE has been ordered not to recognize the UE at its Knolls II atomic plant and the University of Chicago the United Public Workers at its Argonne Laboratory. Other unions are happy, though, because AEC lifted the ban on union recognition which has been in effect at atomic installations outside of Oak Ridge. Prerequisite for recognition, however, is NLRB certification.

Practical Builder has struck back at critics who say that the home building industry is old-fashioned. In a nation-wide survey, it found time-saving, labor-saving electrical devices in use everywhere.

Ready to go on the road this fall is Westinghouse's "Productive Power Show." It has been kept under wraps since its preview in 1946 to avoid stimulating more industrial power use than utilities could handle. Its forthcoming tour can be taken as a sign that an easing of the capacity situation is in sight.

Alan Johnstone, former general counsel of the Federal Works Agency, is opening private law offices in Washington, D. C., and Charleston, S. C. He left FWA to run for the Senate from South Carolina, where he campaigned largely on his record of championing the Santee-Cooper project and other federally backed power developments. He was soundly defeated by incumbent Senator Maybank in the recent primary.

Prescott, Ariz., residents voted down a natural gas franchise for the Arizona Power Co. The reason: Gas and electricity are competitors; the power company would be in a position to retard gas expansion.

Britain's *Electrical Review* casts new light on the activities of UNRRA, which in early post-war years was the world-wide relief agency of the United Nations. It discloses that an electric chair was installed in the Addis Ababa (Ethiopia) jail, a gift of UNRRA. Seems as if UNRRA was acquainting the world with the American way of life—and death.

Though steel is still in tight supply, a brighter future is coming. On the basis of production for the first nine months, the industry is looking forward to producing over 64,000,000 tons of finished items in 1948. This would top the previous high of 63,251,000 tons in 1944.

Notes From The News:

TVA in a pre-flood-season summary emphasized the success of the system in averting floods in the area . . . Alabama Power Co has just paid its state hydroelectric kilowatt-hour tax bill of $477,782.81. The tax is levied only on privately owned companies and goes into a special state education fund . . . The New Brunswick Electric Power Commission is to have three instead of five members . . . The Cowlitz PUD, which not too long ago took over the Puget Sound P&L system in the county, is going to sell the Kalama River hydro plant, probably for scrap . . . The Seminole Electric co-op, which hopes to build an $8,000,000 generating station in Central Florida when REA

lends it the money is considering building it in Marion County . . . Gross value of Canada's electrical manufacturing industry is expected to reach $400,000,000 in 1948, about 10% greater than last year.

Output of Grand Coulee has been exceptionally high in recent weeks. The plant has been turning out over 27,000,000 kwhr every day with great regularity. Its 108,000-kw generators have been operating at a 126,000-kw capacity . . . Employees of Alabama Power Co have worked more continuous accident-free man hours than those of any other utility in the United States.

Industries of the Pacific Northwest may be asked to reduce their power use this fall as much as 20%, C. A. Erdahl, public utilities commissioner of Tacoma, has warned . . . Appalachian Electric Power will spend $1,120,000 this year for rural electrification in its Roanoke District alone . . . TVA will add to its system two 32,000-kw units some time this month. In January two more will be ready . . . Harold Kramer, head of the Nebraska Public Power System, describes the Reclamation-NPPS agreement on marketing of Missouri River power as "a perfect set-up."

British Columbia Electric Railway Co sponsors a series of outdoor band concerts every summer . . . AFL Boilermakers in California have struck for higher wages and other concessions. Work has stopped on Pacific G&E's Station P and the Los Angeles Water & Power's Harbor steam plant . . . The Navy is readying its power train which has been tied in with the Salt River Valley Water Users Association System at Tempe, Ariz., for reshipment to the Mare Island Navy Yard at San Francisco.

Copper production in the U. S. rose to 847,563 tons in 1947, up 39% over 1946 . . . Independent appliance and radio dealers in New York City are after the manufacturers and distributors for larger discounts . . . Harold Christoffel, under whose leadership Local 248, UAW, lost a lengthy strike at Allis-Chalmers' West Allis plant, has been expelled from the union along with eight other former officers. They were charged with misusing $83,000 in union funds.

CONSTRUCTION:

The eastern embankment on the South Carolina abutment of the Clark Hill dam has been completed, six months ahead of schedule . . . Lower Colorado River Authority will build a new transmission line from Llano to Mason, Tex., this fall . . . Arkansas P&L is building a $350,000 service building at Little Rock. Transformer, stores, transportation, meter, and construction departments will be grouped there . . . British Columbia Power Commission is investigating a small hydro site on Silver Creek, west of Hope.

D. W. JARDINE, president of the Pennsylvania Electric Co, unveils name plate at the dedication of the 70,000-kw Warren Station. Penelec now has a total capacity of 410,000 kw

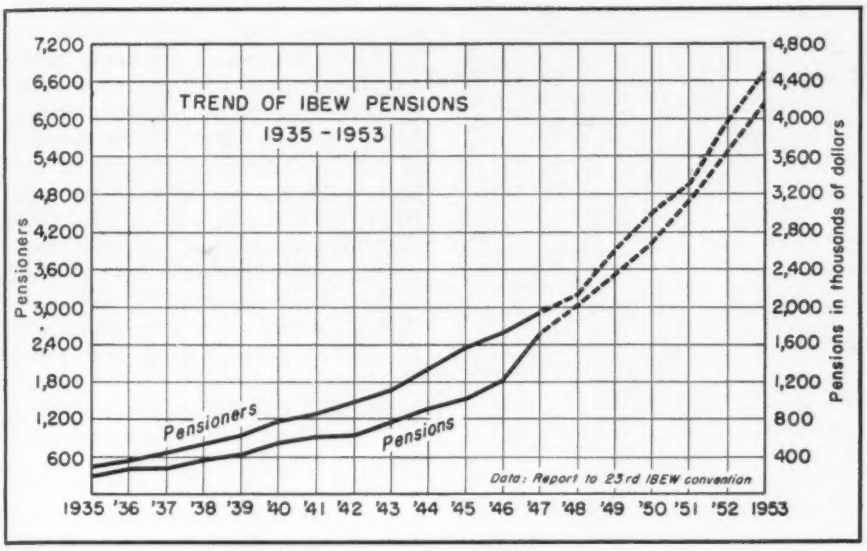
Construction has been started on the $180,000,000 Folsom Dam on California's American River. Army Engineers are building the 280-ft high dam. Plant capacity will be 75,000-kw . . . Calgary Power is now building the final link, a transmission line, in its new Ghost River power development . . . Ontario's critical power supply has been given a slight boost. At Stewartville, 80,000-hp in three units has been added . . . Ground has been broken for the $10,500,000 Plant Yates of the Georgia Power Co, near Newnan.

FINANCIAL:

Northern Virginia Power Co has amended its charter to increase the maximum amount of its common stock from $15,000,000 to $20,000,000 . . . FPC has approved a Northern States Power plan for eliminating $3,385,880 from its electric plant accounts . . . Net income of Virginia Electric & Power Co for August was $271,068.77, a drop of nearly $200,000 from the $470,517.24 of August, 1947.

Otter Tail Power Co has applied to FPC for authorization to issue 141,490 shares of common stock at $5 par value a share . . . Detroit Edison stockholders have been invited to a special meeting, Oct 26, at New York, to vote on a proposal to issue $47,000,000 of convertible debentures . . . Commonwealth & Southern will sell all of its 400,000 shares of Southern Indiana G&E, a wholly owned subsidiary . . . The Kentucky PSC has authorized the Kentucky Utilities Co to sell $1,250,000 worth of common stock to the Middle West Corp, which owns all KU common.

Sale of Tallahassee's $5,000,000 power plant bond issue this month will raise the Florida city's total obligations against revenue from municipal utilities to $7,350,000 . . . Low water on the Susquehanna made necessary greater use of steam stations and increased production costs of Consolidated of Baltimore $685,000 in the first eight months of 1948.



THE ACTUAL AND THE POTENTIAL of IBEW's pension program is shown above. Thus far, utilities haven't been asked to contribute. But they must bargain on the subject. So

Pensions Are Becoming Important

WHERE IS MANAGEMENT headed on pension costs, or the cost of health, disability, and other employee benefits?

Gone are the days when you gave, altered, or took away an employee benefit plan to suit your business situation. For there's been a big change since the days when union leaders scorned these benefits as "paternalistic."

More and more unions are getting welfare benefits for their members, paid in full or in part by employers, and still more want them. Since the war, many employers have signed up for pensions or health benefits or both. The Bureau of Labor Statistics recently found that more than 3,000,000 workers get some kind of welfare benefit under a union contract. In 1945, it could find only 600,000.

And for those employers who do not now provide such benefits, the unions have the recent U. S. Circuit Court of Appeals decision in the Inland Steel Co case as a weapon to force bargaining on them. Unions also are given a voice in existing benefit plans which have operated outside the union contract.

This last point is of particular importance to the electric utility industry, which has been outstanding in giving its employees security and protection against sickness and old age.

In 1945-46, for instance, BLS surveyed 11 industries. It found that insurance and pension plans were most prevalent among electric light and power employees. Eighty-six percent of the 130 companies checked in the industry had them. Most of them—78%—had life insurance coverage for the workers. There were 37% with health insurance and 35% with retirement pensions.

It is safe to assume that most of them were installed unilaterally by employers and were not part of a union contract even where unions represented the workers. This picture is likely to change because of the growth of unionization and the union policy, encouraged by National Labor Relations Board and the court decision, to put them in contracts.

The Inland decision is being appealed to the Supreme Court. If it is upheld, there's a chance that Congress might step in to remove employee welfare benefits from the field of compulsory bargaining. If Congress doesn't go that far, it may at least amend the regulatory provisions of the Taft-Hartley Act on employer-supported welfare plans so as to assure sound plans and protect equity of individual workers.

While the cost of most pension plans is figured on the basis of actuarial studies and the programs are written by insurance companies, two big ones set up since the war are not. One is the welfare and retirement plan of the United Mine Workers and the coal mining industry. The other is the National Electrical Benefit Fund put into effect in May, 1947, by the National Electrical Contractors Association and the International Brotherhood of Electrical Workers, AFL.

These plans are financed on a current basis with no provision for setting up reserves. The miners' fund grows from the 20 cents a ton royalty on each ton of coal mined. The electrical contractors are asked to pay 1% of their IBEW payroll into a fund to match the 60-cent monthly contribution of the IBEW member.

As you can see, the amount going into these funds will decrease when business falls off, and the demand for pension payments will increase. The real test for these plans, then, is in the future. Uncertainty of what's ahead caused the IBEW leadership to oppose, successfully, all attempts at its recent convention to liberalize the pension plan in the electrical industry.

While this plan does not now affect the utility branch directly, it is worth watching. The IBEW estimates that about 30,000 of its 100,000 members in the electric power industry are "A" members participating in the pensions, which are supported 50% by the contracting employers. If the plan runs into trouble, the utilities can look for pressure from the IBEW for them to kick in, too.

NECA agreed to help the IBEW pension plan, begun in 1928, because it was running in the red. IBEW "benefit" members paid 37 cents a month and got $40 pensions on retiring. At the beginning of 1947, after the agreement had been reached with NECA, the pension was raised to $50 a month payable at age 65 after 20 years in the IBEW. The member pays 60 cents a month.

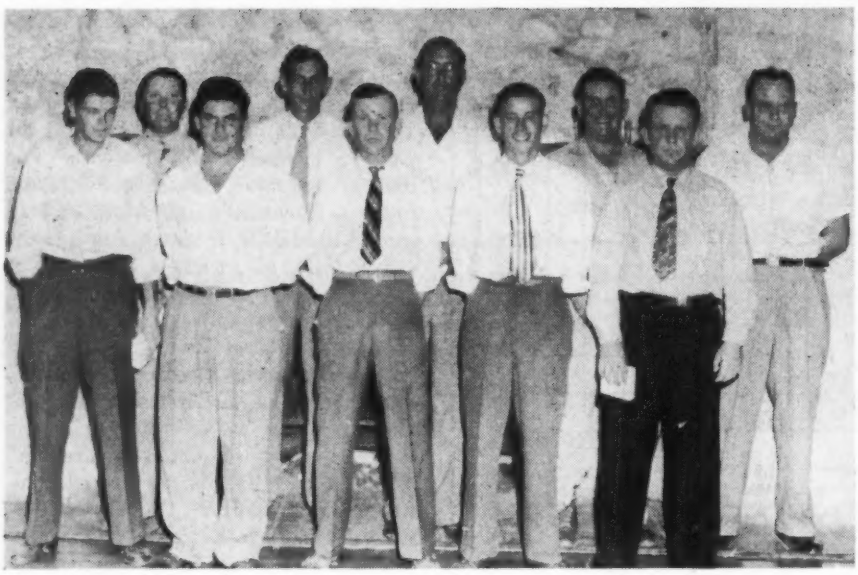
Contractors Pay into Fund

The NECA-IBEW agreement requires that all electrical contractors, whether NECA members or not, contribute 1% of the wages paid to IBEW members. The money is collected by a nine-man joint benefit board which turns it over to a board of trustees, as required by the Taft-Hartley Act, for making the payments.

The board turns over to the trustees an amount not to exceed what the IBEW has collected from its members. The contractors have kicked in $2,300,000, which is $500,000 less than the IBEW has raised. But the board expects to make up the deficiency as more contractors participate. There are now 7,016 of 10,000 contractors participating.

Only 200,000 of the IBEW's 450,000 members have joined the pension plan, and about 3,000 are on pension. IBEW figures that the number of pensioners will double in the next five years if the trend over the past 12 years continues (see chart).

It is hoping there will be enough money available to carry them without reducing the pensions or assessing the participating members. The constitution permits a $1 assessment whenever the union's pension fund balance, not including the contractors' share, falls below $1,000,000. It stood at $1,968,000 on June 30.



UTILITY INDUSTRY HEROES are these members of a Georgia Power & Light Co line crew. They have just received Claude L. Matthews Valor Award medals for their courageous action in extinguishing a fire that was consuming poles and crossarms supporting an important transmission line. The award was announced at the last EEI convention

Supreme Court Will Hear GRDA, Engineers PS Cases in Fall Term

GRAND RIVER DAM AUTHORITY'S petition for review of a $1,000,000 judgment returned against it by Oklahoma courts will be one of the first utility cases heard by the U. S. Supreme Court when it opens its fall session Oct 11.

Only one other important case involving an electric utility was on the court's docket last week. This was a protest by common stockholders of Engineers Public Service Co against the dissolution plan approved for Engineers by the Securities and Exchange Commission under the Holding Company Act of 1935.

GRDA asked the Supreme Court last year to review the judgment awarded to the Grand Hydro Corp, Tulsa, Okla. In December, the court refused to take up the case but, after a rehearing, reversed itself last March and set the argument for the October session. The case dates back to 1939, when the Oklahoma agency and the company asked the state courts to set a price on property deeded by Grand Hydro to GRDA for the site of the Grand River Dam and hydroelectric plant.

The proceeding dragged on until 1945, when a county court awarded Grand Hydro an $800,000 judgment, plus interest at 6%. It is estimated that the interest will make the judgment worth more than $1,000,000 to Grand Hydro unless the decision is upset. The judgment was affirmed by the Oklahoma Supreme Court.

A new element in the case is the intervention of the federal government. At the request of the Justice Department, Federal Power Commission attorneys will go before the Supreme Court next week to testify on the interest of the federal government in the Grand River project. GRDA bonds in the amount of $13,900,000, covering the bulk of a federal loan for construction of the project, are held by the Federal Works Administration.

The case also may have some bearing on GRDA's pending acquisition of steam generating facilities at the war surplus Oklahoma Ordnance Works, near Choteau, Okla. War Assets Administration has contracted to sell these properties to the agency for $3,500,000, but GRDA reportedly has not completed financial arrangements for the deal.

Common stockholders of Engineers Public Service have challenged SEC's plan to pay off preferred stockholders in cash during liquidation of the company. The SEC method calls for payment for preferred shares at a rate based on the call rate if the utiltiy were a going business. Common shareholders contend the rate should be based on the charter-term rate since the company is undergoing involuntary dissolution.

SEC attorneys said they are anxious for the court to establish a "fair and equitable" plan for payment of preferred stockholders. Several similar cases now before SEC, with a total of some $23,250,000 in dispute, hinge upon settlement of the issue, they said.

Another interesting regulatory problem is involved in the dispute over $2,760,000 in revenues of the Interstate Natural Gas Co which were impounded as rate overcharges by order of the Federal Power Commission. Three pipeline companies, customers of Interstate, and the local companies served by these pipeline distributors are after the funds.

The case arose after FPC took jurisdiction over Interstate's rates and service with the sanction of the high court. Interstate's gas-gathering operations are local, but it was held subject to federal regulation because of its sales of natural gas to interstate pipeline companies.

A lower court awarded the $2,760,000 to the pipeline companies, but FPC and several state commissions contend that ultimate customers should get the funds.

•

Buffalo Niagara Electric Gets Financing Approval

The way was cleared last week for the incorporation of the new Buffalo Niagara Electric Corp. The New York Public Service Commission authorized the issuance by the new company of $79,000,000 par value of preferred stock and 9,580,989 shares of common stock with a stated value of $95,809,890. The new securities are to be exchanged for the outstanding stocks of Central New York Power Corp, New York Power & Light Corp, and Buffalo Niagara Electric Corp, which are involved in the merger.

The new consolidated corporation has been authorized to issue, not later than Dec 31, the following securities:

Preferred stocks, 200,000 shares with a par value of $20,000,000 and a 3.4% dividend rate, to be exchanged, share for share, for an equal number of shares of Central New York.

Preferred stocks, 350,000 shares with a par value of $35,000,000 and a 3.6% dividend rate, to be exchanged for an equal number of shares of present Buffalo Niagara.

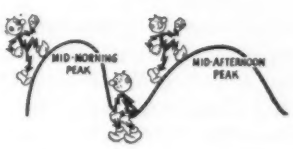
Preferred stock, 240,000 shares with a par value of $24,000,000 and a 3.9% dividend rate to be distributed to present holders of 240,000 shares of N. Y. Power.

The new common stock will have no par value but will have a stated value of $10 a share. It is to be issued in exchange for 1,581,358 shares of Central, 1,300,000 shares of N. Y. Power, and 3,000,000 shares of existing Buffalo Niagara. Niagara Hudson Power Corp has been authorized to acquire all of the new common.

"Dr. Roberts, Can We Take all these Patients at the Same Time?"

"Doc" Roberts just can't do it! Even with the best mechanical aids, he must take his "customers" one at a time. But it's different in the electric business! For electricity must be manufactured and delivered as you need it. And there are periods every day when you and all your neighbors use electricity at the same time.

During the "peak" periods, mid-morning and mid-afternoon, when almost everybody calls for electric service, we have to send out more and more current to meet increased needs. Often our generators and transformers are taxed to the limit. For serious delays in delivery of vital electric equipment have prevented us from keeping ahead of this community's use of low-cost electricity.



At present, it's the "peak" periods that worry us most... when *your* demand for service is piled on top of the demands of *thousands of other customers*...but we'll be doing our best to get over these daily "humps" during the summer.

Kansas City
POWER & LIGHT COMPANY

HUMOROUS DRAWINGS headed a series of newspaper advertisements used by the Kansas City Power & Light Co to explain to its customers the difficulties of handling peak loads during the summer months. The ads were very effective in winning cooperation of customers

Reclamation Announces 2,882 Will Be Dismissed

Details of the dismissal of 2,882 Bureau of Reclamation employees were announced this week by Reclamation Commissioner Michael Straus. Only a few transfers will be made to other offices which are understaffed. Personnel of all but one regional office are being dismissed.

Straus said the general lay-off was forced by the $48,000,000 ceiling set by Congress for the over-all Reclamation Bureau payroll for fiscal 1949. A committee of Bureau officials studied the employee rolls and eliminated jobs to spread the dismissals with "the least possible effect" on project operations.

The Washington office, whose staff was reduced by 30% last year, was not affected. There will be no dismissals at the Region IV office at Salt Lake City since it was understaffed. Regional offices, their headquarters location, and the number of employees affected in each region follow:

Region I, Boise, 429; Region II, Sacramento, 1,114; Region III, Boulder City, 285; Region V, Amarillo, 99; Region VI, Billings, 533; Region VII, Denver, 202; Denver Engr Office, 220.

Board Studies Protection of Power Plants in War

Protection of electric generating plants and other major power facilities against bomb damage in the event of war is being studied by the Munitions Board.

At the Board's request, the Army Engineers are investigating steps for protection of hydroelectric plants and facilities. Studies covering steam generating equipment and allied installations probably will be undertaken later, it is expected.

Information on the project is under security restrictions, but Army sources disclosed this week that they were studying "existing and typical" hydro plants. On completion of these investigations, the Chief of Engineers will report to the Munitions Board on proposed engineering and policy procedures.

Recommendations of the Engineers on hydro plant protection are expected to be made a part of an eventual report by the Munitions Board on defense of all utility facilities of major importance to the nation's wartime requirements. These studies probably will cover a wide range of protection measures, including relocation of proposed plant sites, engineering design changes and emergency operating plans.

The problem is of extreme and immediate importance to the power industry, with its huge program of expansion now on the drawing boards or beyond, and to federal agencies constructing hydroelectric facilities. Munitions Board will admit only that it is making studies, gives no idea how far its planning has progressed. But it is unlikely that the Board can come up with any comprehensive protection program in the near future, unless a national emergency develops.

Spokesmen for the Engineers emphasized that no actual protection work was in progress on any Army projects. Such construction would have to be approved by higher authority, probably Congress. But the Army studies are expected to develop valuable cost estimates, as well as design data, for protective works.

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Pension Plan Approved

Memphis has approved a pension plan for about 3,000 city employees, which will be the pattern for one covering some 2,000 employees of the Memphis Light, Gas & Water Division. The ordinance, made effective Oct 1, calls for employee contributions of 4% of their salaries, with 6% to be given by the city. Pensions will amount to half the annual compensation.

GROUND IS BROKEN near Campbell, Mo., for 30,000-kw "Jim Hill" steam-electric generating plant designed by and being constructed under supervision of Ebasco Services, Inc., for Arkansas-Missouri Power Co. The $5,500,000 plant is scheduled to be put in operation late in 1949. Arkansas-Missouri officials taking part in the ceremony are, left to right, President James Hill, Jr., Chief Engineer George Pollock, Meter Superintendent W. L. Crafton, Property Records Chief Bancroft Terry, Auditor Franklin Atkinson, Personnel Director Joe T. Hughes, Rate Engineer Glenn Ladd and Treasurer Charles R. Newcomb

Puget Sound P&L Sells Last of "Fringe" Property

Puget Sound Power & Light Co, Seattle, has sold another segment of its facilities in western Washington, this one in Grays Harbor County, to the Grays Harbor PUD for $1,024,000 plus the value of accounts receivable.

This is about the last of the "fringe" operations which Frank McLaughlin, Puget Power president, previously had indicated the company would sell. The remaining properties located in areas where PUD's have been established in Washington constitute a "closely knit, economic, interconnected system, and piecemeal dismemberment by counties would involve substantial severance and operating difficulties," McLaughlin said.

The company in recent months has sold distribution systems in eight counties for about $14,000,000. It has retained its distribution system in ten counties and most of its generating plants. McLaughlin said the remaining properties would be considered in two groups for possible future sales transactions. One would include the Seattle system and the Rock Island generating plant near Wenatchee, while the other would be the rest of the company system.

The company is expected to ask $40,000,000 or more for its distribution system in the Seattle competitive area and nearly as much for the Rock Island plant, which cost about $16,000,000 to build in 1931, when costs were much lower than today. These figures are much higher than the city is reported to be willing to pay.

Grays Harbor PUD has been serving the major portion of Grays Harbor County, including the cities of Aberdeen and Hoquiam. The Puget Power purchase was financed by the sale of $1,217,000 of 2¾ and 3% bonds.

Less than 1% of the company's 1947 total gross revenue and about 1% of total electric customers are involved in the sale.

Lewis County Public Utility District has purchased Puget Sound Power & Light Co properties and accounts in Lewis and Pacific Counties, Wash., for approximately $2,709,000.

This area has 7,673 customers, with a gross of $623,134 yearly. It represents about 2% of Puget Sound P&L's 1947 total gross revenue and less than 3% of its electric customers. The purchase was financed by issuance of a $3,850,000 bond issue.

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Florida Power Ups Pay

Wage increases comparable to those given recently by several other Southeastern utilities have been granted by Florida Power Corp to the International Brotherhood of Electrical Workers (AFL) in an agreement covering 631 employees in six locals. The new raise, together with adjustments made last April and year-end adjustments to be made, means an annual wage increase of $435,000.

Electric Energy Sales in June Advanced 10%

Sales of electric energy to ultimate customers in June 1948 totaled 19,297,128,000 kwhr, the Edison Electric Institute reports. This was a 10.0% increase over the 17,546,119,000 kwhr sold in June 1947.

Revenues from ultimate customers in June amounted to $344,778,500, compared with $309,630,500 in June 1947, an increase of 11.4%.

For the 12 months ended June 30, the average use per customer advanced to 1,505 kwhr from 1,385 kwhr for the preceding year, an increase of 8.7%; the average annual bill to $45.60 from $43.49, an increase of 4.9%; revenue per kwhr dropped to 3.03¢ from 3.14¢, a decrease of 3.5%.

Classification of Sales, June

Kilowatthour Sales June	Million KwHr 1948	1947	Percent Change
Residential or domestic	3,815	3,369	+13.3
Rural (distinct rural rates)	510	558	— 8.6
Commercial or industrial			
Small light & power	3,482	3,060	+13.8
Large light & power	10,261	9,356	+ 9.7
Street and highway lighting	164	154	+ 6.5
Other Public Authorities	499	475	+ 4.9
Railways and railroads			
Street and Interurban	310	345	—10.1
Electrified steam railroads	204	186	+ 9.5
Interdepartmental	53	44	+21.0
Total to ultimate customers	19,297	17,546	+10.0

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Higher Rates Outside City Upheld by Florida Court

A Lakeland, Fla., 10% increase in power rates to customers living outside the city limits has been upheld in effect by Circuit Court Judge Don Register.

The judge ordered four allegations in a bill of complaint stricken from the bill, but left the road open for the plaintiff to present additional particulars to support his charge that the increase is illegal. The ruling said that municipal power plants are operated primarily for the benefit of the city's citizens and that persons residing outside the city limits, who pay no municipal taxes, have no right to claim the same rates.

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Holbrook Named to PUC

Frederick H. Holbrook, speaker of the Connecticut House of Representatives, has been named a member of the Public Utilities Commission. He succeeds the late Carl M. Sharpe. Holbrook will resign his posts as speaker and as commissioner of food and drugs.

Power Shortage Grows More Acute, Says REA

Rural Electrification Administration made its annual count of electrified farms last week (Sept 30) and came up with the conclusion that the "national power shortage" is "growing more acute."

Incidentally, REA also found that 4,019,476 farms, 68.6% of the nation's total, were receiving central station electric service as of last June 30. About 1,840,000 farms are still without central station service, leaving "a formidable job of rural electrification" still to be completed, REA reported.

Commenting on the REA report, which was based on surveys of the Agriculture Department, Administrator Claude Wickard noted that many of the unserved farms are located in sparsely-settled or almost inaccessible areas. But power supply problems make the job of serving both prospective and existing rural consumers more difficult.

"The national power shortage is a serious obstacle to expansion of rural power service," Wickard said. "Some applications for line construction now pending cannot be approved because there is no power available in the area. REA cooperatives in many areas are finding it impossible to purchase. . . additional amounts of power they need. . ."

Other significant statistics in the REA report included the following:

Nearly 3,275,000 farms have received central station service since 1935, with 53.2% of these served by REA-financed facilities. Ohio, with 97.6% of its farms electrified, is nearest of any state to complete rural electrification; South Dakota, with 76.1% of its farms unserved. has the lowest ranking. A total of 444,835 farms received central station service between June, 1947, and June, 1948—320,677 of them reached by REA-financed distributors.

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Michigan Anti-Strike Act Held Invalid Only in Part

The Michigan Supreme Court has clarified its recent decision (EW, Sept 18, Page 5) which had been interpreted as voiding the Bonine-Tripp Labor Act. The court now says it had ruled unconstitutional only those parts of the utility anti-strike law that provided for compulsory arbitration, with the use of circuit court judges as arbitrators of labor disputes in public utilities.

This leaves in effect other features of the law, including mediation procedures, pre-strike balloting, and bans on mass picketing and secondary boycotts.

TWO NEW DIRECTORS of Arkansas Power & Light Co are sworn in by President C. Hamilton Moses, seated. Directors are Joe C. Hardin, center, and Gordon E. Young

Utility Power Plants Set August Coal Use Record

The highest August coal use by electric utility power plants ever recorded has been reported by the Federal Power Commission for August. Consumption totaled 8,554,933 tons, 10.1% more than the 7,772,512 tons used during August, 1947, and 6.5% above July's figure.

Of the August consumption, 8,202,956 tons were bituminous and 351,977 tons anthracite. Use of bituminous coal increased 6.5% over the preceding month, and anthracite 5.3%.

Stocks of coal on hand at power plants Sept 1 stood at their highest level on record, 23,489,550 tons, 31.2% more than a year ago and 12.8% above Aug 1, 1948. Of this total 21,106,686 tons were bituminous and 2,382,864 tons anthracite. Based upon the August rate of consumption, the Sept 1 stocks were sufficient to last 85 days compared with 80 days' supply a month earlier and 71 days a year before.

August gas usage set a new monthly record. Consumption was 51,588,454 Mcf, 23% more than August, 1947, and 6.5% above July, 1948.

Fuel oil consumed during August was 3,118,854 bbl, an 18.1% decrease from the same month in 1947 and a decrease of 3.1% compared with July, 1948. Based upon August use, fuel oil stocks on hand Sept 1 were sufficient to last 83 days compared with 82 days a month before and 51 days a year before. Stocks totaled 8,319,376 bbl.

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Use of Radio Explained

To speed up and improve service on its five-station, 40-car radio system, Toledo Edison Co has issued a small instruction booklet to all employees using the radio. The booklet stresses use of radio for emergency use only, knowing what one wants to say before starting the call, speaking clearly, and following the prescribed means of contacting other stations and cars.

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Consolidated Edison Asks Long Island Purchase

Consolidated Edison Co has filed a petition with the New York Public Service Commission seeking approval to acquire control of the contiguous Long Island Lighting company.

The acquisition, backed by Long Island Lighting President Edward F. Barrett and by its preferred stockholders on the ground that it would effect operating economies, is contingent upon consolidation of Long Island Lighting with its two subsidiaries, Queens Borough Gas & Electric Co and Nassau & Suffolk Lighting Co. Plans for the latter consolidation were tentatively approved in major part last June by PSC and are pending before SEC.

Two alternative plans of acquisition, neither specifying the price, were proposed in the petition. Both contemplate issuance by Consolidated Edison of either common stock or convertible debentures, requiring prior approval by Edison stockholders. One calls for Consolidated Edison to exchange these securities for the assets of the proposed reconstituted Long Island utility. The other, which would require approval by Long Island stockholders, is for Consolidated Edison to create a new subsidiary to make the exchange.

The present Long Island system provides electric service to 240,000 consumers and gas to 186,000 customers in a 1,200 sq-mi territory that embraces Long Island east of New York City, in the Rockaway district of Queens, and in parts of Brooklyn.

Northwest Told to Plan Own Power Development

The Pacific Northwest should speed plans for its own power development, Secretary of the Interior J. A. Krug recently told a power conference at Tacoma, since the federal government is not likely to provide enough electricity for the area during the next few years. The conference of industrialists and power utility officials was sponsored by the Northwest Utilities Conference Committee.

The expected power shortage might be alleviated by equipping barges with generators for emergency power in critical areas, he said.

Kinsey Robinson, president of the Washington Water Power Co, declared no single company could afford to generate power at a cost of $30 a kilowatt year to compete with Bonneville Power Administration at $17.50 and suggested organization of a "generating corporation" to be financed by the RFC. By division of the burden, the extra cost might be met, he said.

Puget Sound Power & Light Co's Rock Island Dam on the Columbia was mentioned by several speakers as the best chance for immediate development of new power. The company is in the position, however, where it probably will have to sell the dam within a few years. Now providing 80,000 kw, the dam and plant can be enlarged to provide an estimated 240,000 kw.

The conference worked out a tentative program to contact all industries in the Pacific Northwest to determine peculiarities of their electrical loads. From this information the committee later will be able to determine a cutback procedure if there is an equipment failure or less than average water during the winter months.

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No More Power Scarcity, Utility Head Tells Reno

Frank Tracy, president of Sierra Pacific Power Co, has assured Reno's worried city officials that his firm's $4,017,000 expansion program will prevent any recurrence of the 5,000-kw shortage that brought a brownout to western Nevada last spring.

In spite of his statement, Reno officials are going ahead with their plans to retain priority on 90,000 kw of Shasta Dam power reserved last year by Nevada's Colorado River Commission in an agreement with the Department of the Interior. There is no way to get the power from Shasta to Reno at present, but the city officials are retaining their right to it in case of another shortage.

SEC RULINGS

Wisconsin Power & Light Co, Middle West Corp subsidiary, has been authorized to sell $5,000,000 of first mortgage bonds, Series C, due 1978, at competitive bidding. The company also has been permitted to sell 320,232 additional shares of $10 par common stock at $13.50 a share. Stockholders of record at the close of business Sept 3 will be allowed one new share of common stock for each four shares held. Middle West plans to subscribe for and purchase an additional 169,458 shares of the new offering. Company employees will be given the right to purchase a total of 12,000 shares of the stock at $13.50 a share if unsubscribed by stockholders. No underwriting is involved. (Release No. 8499).

Madison (Wis.) Gas & Electric Co, subsidiary of American Light & Traction Co, has been allowed to enter into an 18-month credit arrangement with Harris Trust & Savings Bank and The First Wisconsin National Bank of Milwaukee. The banks will advance a maximum of $2,000,000 to Madison Gas at 2¼% interest. The company will use the funds for construction. (Release No. 8507).

Republic Service Corp's amended reorganization plan has been approved. The company's original reorganization plan had already been approved by the commission and the U. S. District Court at Wilmington. So that the stockholders might benefit from the capital loss carry-over resulting from divestment of subsidiaries, the plan was amended to put off temporarily the activation of a new corporation to be set up under the plan. Under the changed plan, Republic will amend its charter to provide for sale of 100,000 shares of new $10 par common stock, and will borrow $950,000 at not more than 3% interest. Republic's preferred stockholders will receive 70,324 shares of the new common at the rate of four new shares for each preferred share held. Other provisions of the plan remain unchanged. (Release No. 8520).

Memphis Generating Co has been authorized to purchase 5,000 of its $100 par common shares from National Power & Light Co, parent, for $500,000. Latter company owns 44,000 shares of Memphis Generating stock and will use proceeds of the 5,000-share sale to pay a liquidating dividend on its own common stock. (Release No. 8521).

Staten Island Edison Co has been authorized to sell to three commercial banks $1,750,000 of 2% notes to mature in not more than six months. Proceeds will be used to pay off $1,750,000 of outstanding notes. (Release No. 8525).

Consolidated Electric & Gas Co, New York holding company, has received permission to borrow $5,000,000 from two banks to retire current bank notes. (Release No. 8512).

Indiana & Michigan Electric Co, South Bend, Ind., has received SEC clearance on its $25,000,000 first mortage bond offering. (Release No. 8513).

American Light & Traction Co has been released from SEC jurisdiction over $3,800,000 realized from the sale by the company of 190,000 common shares of Detroit Edison Co. (Release No. 8519).

MEETINGS

Pennsylvania Electric Association—Electrical Equipment Committee, Americus Hotel, Allentown, October 21-22. R. E. Neidig, chairman, Metropolitan Edison Co, Reading, Pa.

PREVIOUSLY LISTED

Edison Electric Institute—Prime Movers Committee, William Penn Hotel, Pittsburgh, October 11-12; Transmission and Distribution Committee, New Ocean House, Swampscott, Mass., October 11-12; Electrical Equipment Committee, William Penn Hotel, Pittsburgh, October 14-15.

Pennsylvania Electric Association—Meter Committee, Penn-Alto Hotel. Altoona, October 20-21; Prime Movers Committee, Carver House, Warren, Pa., October 28-29.

Indiana Electric Association—Annual Convention, French Lick Springs Hotel, French Lick, Ind., October 13-15.

Electrochemical Society — Fall Congress, Hotel Pennsylvania, New York, October 13-16.

Missouri Valley Electric Association—Power Sales Committee, Hotel President, Kansas City, Mo., October 15; Accounting Conference, Connor Hotel, Joplin, Mo., October 21-22; Engineering Committee, Hotel President, Kansas City, Mo., October 26; Rural Round Table, The Elms, Excelsior Springs, Mo., October 27; Sales and Rural Conference, The Elms, Excelsior Springs, Mo., October 28-29.

Utility Workers Union of America—National Convention, Washington Hotel, Washington, D. C., October 15-17.

American Institute of Electrical Engineers—Midwest General Meeting, Hotel Schroeder, Milwaukee, October 18-22; Southern District Meeting, Tutwiler Hotel, Birmingham, Ala., November 3-5.

American Standards Association—Annual meeting, Waldorf-Astoria Hotel, New York, October 20-22.

Southeastern Electric Exchange—Accounting Section, Sir Walter Hotel, Raleigh, N. C., October 28-29; General Sales Conference, Atlanta Biltmore Hotel, Atlanta, Ga., November 10-12.

Wisconsin Utilities Association—Commercial and Technical Divisions of Electric and Gas Sections, Pfister Hotel, Milwaukee, November 1-3.

National Electronics Conference—Edgewater Beach Hotel, Chicago, November 4-6.

Public Utilities Association of the Virginias—Annual Meeting, Greenbrier Hotel, White Sulphur Springs, West Virginia, November 5-6.

National Electrical Manufacturers Association—Annual Meeting, Hotel Traymore, Atlantic City, November 8-13.

National Farm Electrification Conference—Congress Hotel, Chicago, November 17-19.

New Jersey Utilities Association—Annual Meeting, Seaview Country Club, Absecon, November 18-20.

American Society of Mechanical Engineers—Annual Meeting, Hotels Pennsylvania and New Yorker, New York, November 28-December 3.

National Exposition of Power and Mechanical Engineering—Grand Central Palace, New York, November 29-December 4.

National Electrical Contractors Association—Annual Meeting, Roney Plaza Hotel, Miami, Fla., November 30-December 3.

Plant Planned for Atomic Power Generation Studies

Construction of the first plant in the United States to be devoted to generation of electric power from nuclear energy will be started next year in Saratoga County, N. Y.

The plant will be part of the facilities of the Knolls Atomic Power Laboratory, operated for the Atomic Energy Commission by General Electric Co. It will occupy 4,500 acres of land 18 miles north of Schenectady. Cost was estimated at between $10,000,000 and $20,000,000.

No power will be sold from the plant, which will be operated for experimental purposes. Its nuclear reactor is one of two now being designed especially for the study of high temperature operation and power production. A different type of reactor, also directed to the problem of power generation by nuclear fission, is planned at AEC's Argonne National Laboratory near Chicago. Both are expected to yield important data leading ultimately to design of reactors that will produce power on a practical scale.

Also under study will be problems involved in "breeding" nuclear fuel. It is hoped that the heat generated in fission will more than replenish the fuel consumed in operation. The breeder-type reactor also is expected to convert non-fissionable Uranium-238 into new fissionable matter.

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Georgia Power to Build 100,000-kw Steam Plant

Georgia Power Co will build a new 100,000-kw. steam plant on the Chattahoochee River between Newnan and Carrollton, President C. B. McManus announced recently.

Preliminary work is to begin this month on the station, which is to be designed for an ultimate capacity of 400,000 kw. Cost of the first unit is estimated at $10,500,000, including connecting transmission. The plant will start operating in the fall of 1950, company officials hope.

Other News

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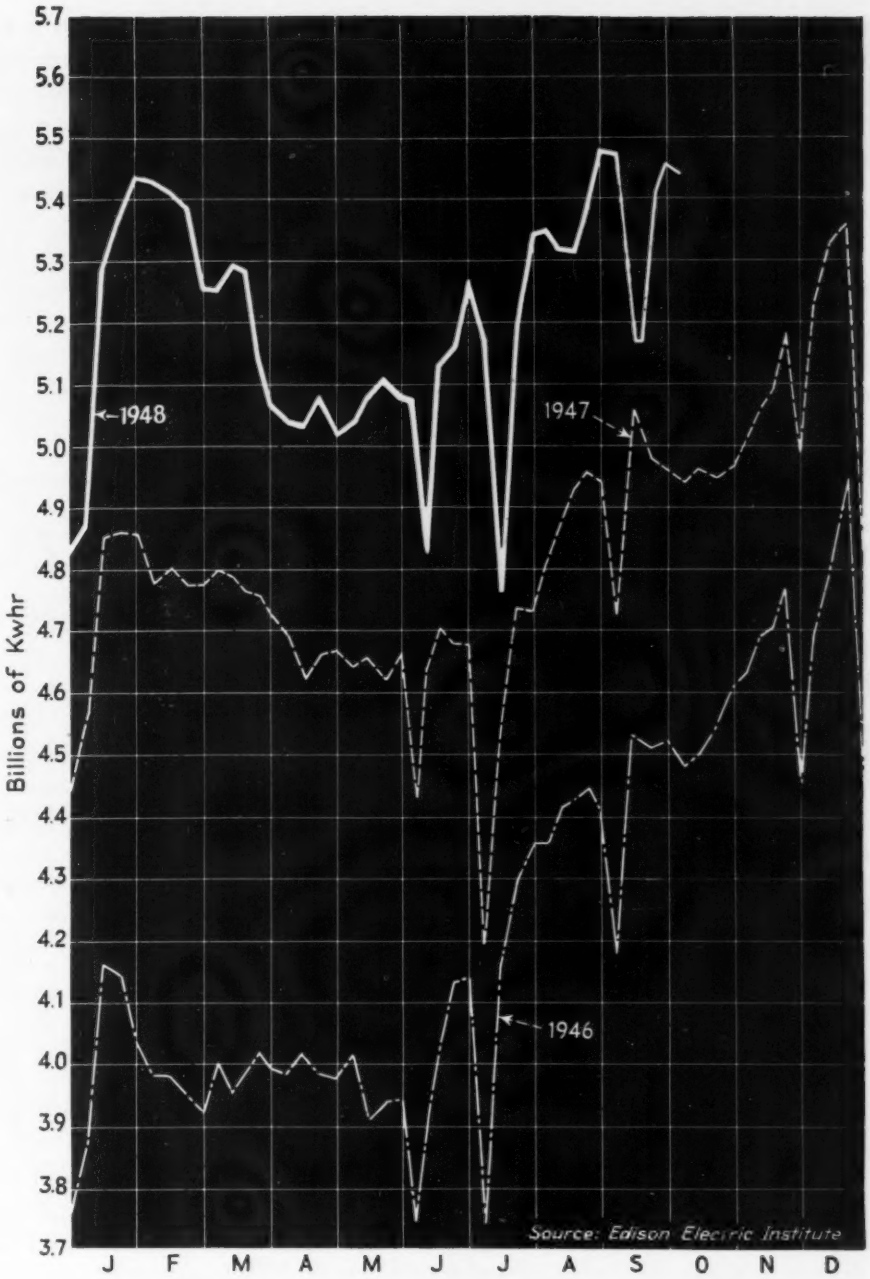


Output Down but December Picture Bright

Output of the nation's central electric stations turned down slightly last week (that ended Oct 2) to 5.448,554,000 kwhr. In this decline, it was only following the trend of the past two years. Since the end of the war, October has been a "slump" month before the big drive to the December peak. Of interest to utilities is the fact that total for the week was 10.4% above that for the corresponding week of 1947. This average 10% rise has been steady for months and shows no signs of lessening.

The 10% figure is significant because if it stays constant, electric utilities will be able to meet the December peak with no more difficulty than in 1947. At the end of July, capacity had increased 7% over that installed a year previously. More plants will raise this figure close to 10%.

Weekly Output, Millions Kwhr

1948	1947	1946
Oct. 2, 5,449	Oct. 4, 4,935	Oct. 5, 4,478
Sept 25 5,461	Sept 27 4,956	Sept 28 4,518
Sept 18 5,426	Sept 20 4,977	Sept 21 4,507
Sept 11 5,166	Sept 13 5,053	Sept 14 4,521
Sept 4 5,470	Sept 6 4,721	Sept 7 4,184
Aug. 28 5,478	Aug. 30 4,940	Aug. 31 4,404
Aug. 21 5,391	Aug. 23 4,953	Aug. 24 4,444
Aug. 14 5,318	Aug. 16 4,923	Aug. 17 4,422
Aug. 7 5,319	Aug. 9 4,874	Aug. 10 4,412

Percent Change from Previous Year

	Oct. 2	Sept. 25	Sept. 18
New England	+ 5.5	+ 6.4	+ 6.4
Mid-Atlantic	+ 7.3	+ 5.9	+ 6.0
Central Industrial	+ 9.8	+10.0	+ 8.8
West Central	+12.8	+15.2	+11.5
Southern States	+13.3	+13.3	+ 9.4
Rocky Mountain	+ 9.3	+ 9.4	+12.5
Pacific Coast	+12.1	+10.2	+11.4
Total United States	+10.4	+10.2	+ 9.0

WASHINGTON COMMENT

WILLIAM B. WHICHARD

Congressional committees which set federal policy on electric power and resource development will come to Washington with a "new look" next year. Already retirements and political setbacks have eliminated key members of a half dozen House and Senate committees. Close election battles may bring further changes.

Accepting political dopesters' forecasts that the Republicans will capture the White House, keep a wide majority in the House, and a narrow one in the Senate, Congressional committees still are due for some major shake-ups. In the Senate, for example, Agriculture and Interstate and Foreign Commerce will get new chairmen.

Chairman Arthur Capper, of the Agriculture and Forestry Committee, has retired. Sen George Aiken, Vermont, ranking Republican on this committee, is expected to give up his chairmanship of the Executive Expenditures Committee to replace Capper. Retirement of the late Senator Bushfield, South Dakota Republican, and Sen Tom Stewart's defeat in Tennessee's Democratic primary took them off the Agriculture Committee. Another member, Republican Senator Wilson, faces a hot reelection race in Iowa.

Senator Aiken can be expected to continue the committee's friendliness toward the Rural Electrification Administration. Nor is REA likely to have much difficulty with the House Agriculture Committee, which may get a new head.

The House committee, under Chairman Clifford Hope, of Kansas, has been sitting on such bills as proposals to restrict REA's authority to grant generating and transmission loans. If Dewey wins, Hope may become his Secretary of Agriculture. This would elevate August H. Andresen, Minnesota Republican and a booster of REA, to the committee chairmanship.

The Senate's Interstate and Foreign Commerce Committee, which acts on nominations and legislation for the Federal Power Commission, Securities and Exchange Commission, and other regulatory bodies, is due for major shifts. Chairman Wallace White, Maine, retired, as did Republicans Moore, Oklahoma, and Hawkes, New Jersey. Senator Stewart's departure leaves four certain vacancies on the 13-man committee. In addition, Democrat Ed Johnson may not be reelected in Colorado.

Committee leadership ordinarily would pass to Senator Tobey, New Hampshire, who may, however, prefer to retain his chairmanship of the Banking and Currency Committee. In that case, Senator Reed, Kansas, would get the job.

The House Interstate and Foreign Commerce Committee does not appear to be facing any drastic changes. Republican William Miller, author of Federal Power Act revisions, has a fight in Connecticut but is expected to win. Two veteran Democrats, both public power boosters, have been definitely eliminated. California's Clarence Lea has retired, and Arizona's Richard Harless quit to wage a losing fight in his state's gubernatorial primary.

The vital Appropriations Committees offer another contrast. The Senate group appears set for another two years, with only Minnesota Republican Joseph Ball facing defeat in a reelection fight. Complexion of the House body hinges upon the elections.

Of course, all bets on the composition of Senate committees are off if the Democrats win control.

TECHNICAL TRENDS

ARCHER E. KNOWLTON

Frequency departures are monitored by a new instrument which converts the departures into phase angle shifts by a quadrature voltage reacting with that from a ring modulator tapped off a standard-frequency resonant circuit.

Pulverizer storage capacities vary and it is well to take the values into account when deciding the characteristics of any throwover scheme for the auxiliary system.

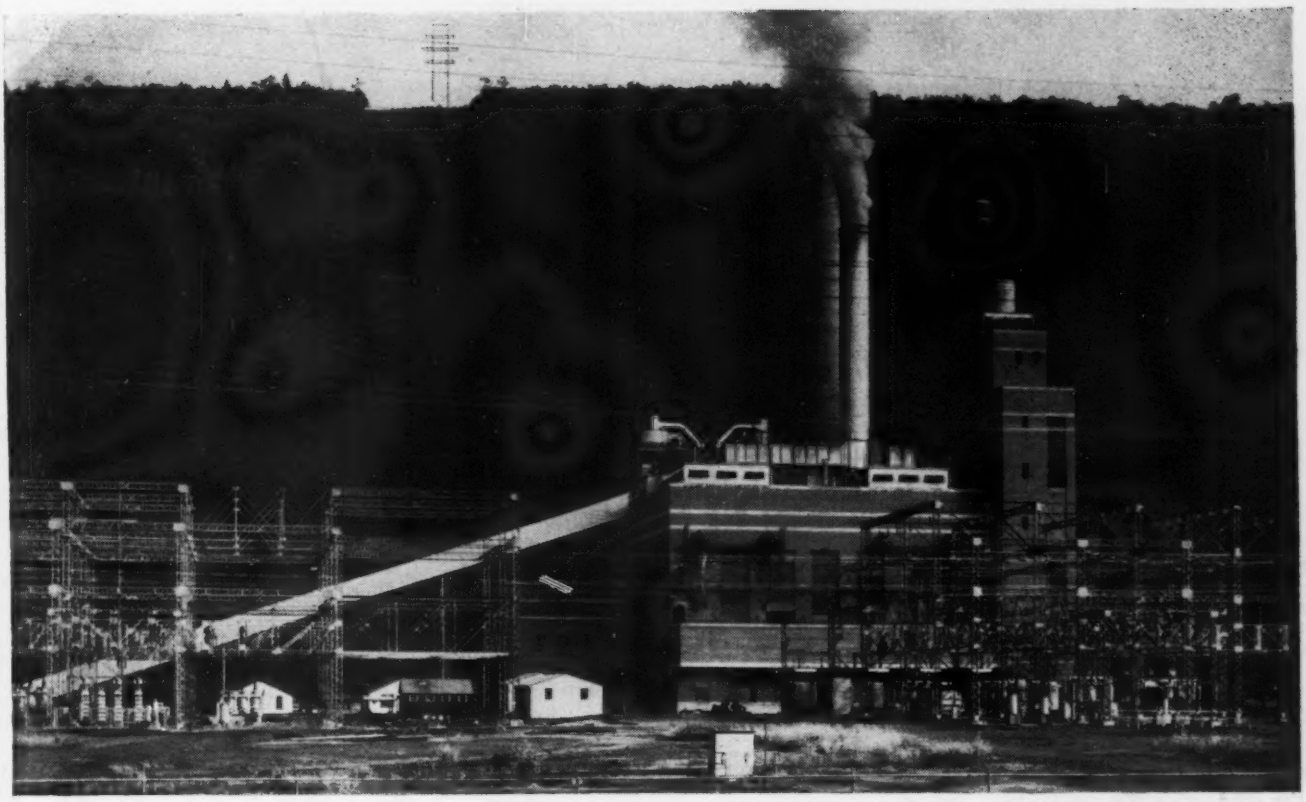
Current-carrying capacity of cables in ducts is really in a nebulous state because much too little is known about thermal conductivity of earths, tile, concrete, etc in sequence and in complex configuration. More and more city load will be routed into those uncertainties.

Slag, ash and soot would never need removal if the surfaces on which they collect could be made non-attractive, non-adhesive and incompatible. It should be worth a thought.

Distribution engineers' goal should be a layout which averts the incessant circuit changes to, at and from substations as load densities persist in rising.

Interruptions on distribution circuits on one system are on the average nearly 5 times as frequent and last more than 12 times as long as those on substation supply feeders.

Substation patterns probably exist in far greater variety than circumstances really warrant. A smaller number might converge to a beneficial degree of standardization of components even if assemblies continue to differ. Safety engineers and maintenance men would probably welcome such a trend.



HUNLOCK STATION originally built in 1925 was expanded in 1947 to house a second 20,000 kw unit and two new 175,000 lb per hr pulverized fuel boilers. Original boilers burned stoker-fired Barley and Rice

Dried Anthracite Silt Is Fuel For Hunlock Station Extension

High moisture content of colliery silt reduced by drying with flue gases from existing stoker-fired boilers. Early operating problems surmounted. Flyash reinjected into furnace to recover free carbon

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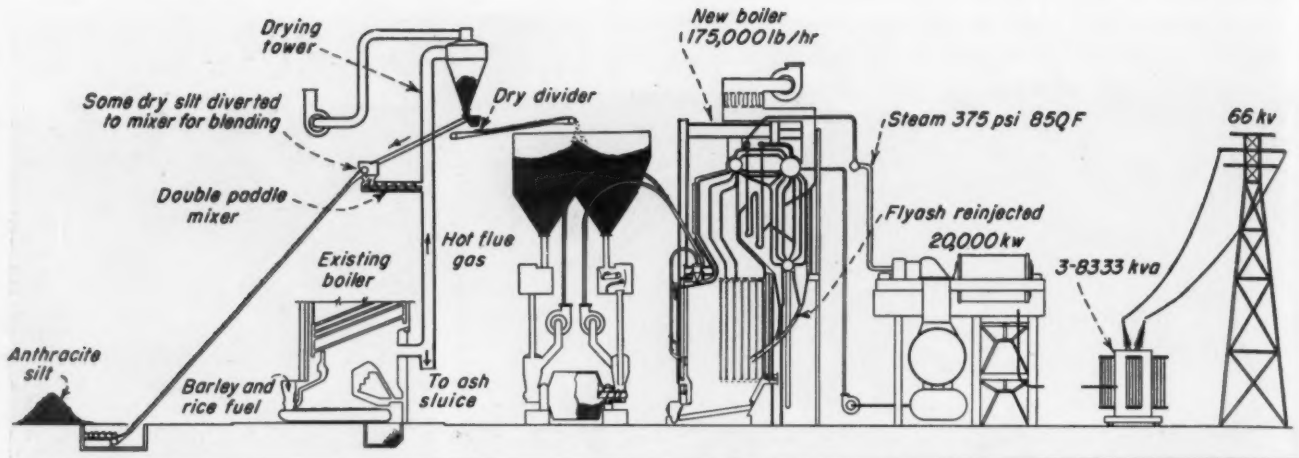
BREAKER SILT, a fine refuse anthracite that is the by-product of grading operations at collieries in the hard coal area of Pennsylvania, was the fuel of choice for the recent 20,000-kw extension of Hunlock Station of Luzerne County Gas & Electric Corp, near Wilkes Barre.

Its selection represented a switch from stoker-fired Barley and Rice, used in the older part of the station, to a type of hard coal which, while relatively untried in the power generation field, has the advantages of low cost per ton, fair heat value and ready availability in the area around the plant.

Silt comes to the plant in a wet condition and must be dried as well as pulverized before it can be burned. At Hunlock this drying operation is accomplished by exposing the silt to hot flue gas from the plant's existing stoker-fired boilers. The operating record of this installation to date embraces last winter's unusually severe temperature conditions which had a bearing on operating experience.

In addition, several interesting departures in the design of this new extension include:—(1) Provision of a generator hydrogen cooling system designed for 15 psi; (2) resort to isolated-phase construction to carry generator leads through a congested plant area; (3) replacement of all existing oil-filled auxiliary power transformers with modern air cooled unit-type substation, and (4) use of a liquid slip regulator and wound rotor type induction motor to secure speed adjustment on induced draft fans.

Hunlock Power Station was originally built in 1925 and extended in



HUNLOCK EXTENSION is designed to burn anthracite silt which comes to the plant in a wet condition and must be dried by exposure to hot flue gas from existing boilers before it can be pulverized and burned. Sketch shows basic pattern of drying scheme

1947. The initial installation consisted of a single 20,000-kw 1,800-rpm turbo-generator using steam at 360 psi 700 F from three 55,000 lb per hr boilers burning stoker-fired Barley and Rice grades of anthracite.

When this installation was made the price of Barley and Rice coal was low and the supply ample. However in the last 20 years the number of domestic stokers has quadrupled the demand for these poorer grades of hard coal. In the last 10 years the price has doubled.

Consequently when the first extension to Hunlock Station was laid out it was decided to use an anthracite fuel that was not only cheaper but in more plentiful supply than Barley. This first extension to Hunlock Station consists of a 20,000-kw 3,600-rpm hydrogen-cooled turbine-generator unit using steam at 375 psi and 850 F from two 175,000 lb per hr pulverized fuel fired boilers.

Anthracite silt was selected as the logical fuel for use in the new boilers. It has a heat value, when sufficiently low in ash, that is slightly higher than Barley; 11,400 Btu per lb vs 10,950 Btu per lb, as fired. The price delivered is less than half, neglecting additional labor and conversion costs.

Its principle advantages as a power fuel for Hunlock Station lay in its ready availability, low cost, and the likelihood that it would be in reasonable supply in the future.

However, silt is not without its drawbacks as a power fuel. Most of these spring from difficulty in handling due to its high moisture content. As received from the collieries silt has a moisture content ranging from 17-20% and about 18% ash. For efficient firing this moisture content must be reduced to about 5%. To accomplish this at Hunlock Station required the installation of a flash-type coal drying addition at a cost of nearly $450,000. This system is capable of producing 50 tons per hr of dry silt (5% moisture) from wet coal of 20% moisture without heating it above 175 F.

Operation of the drying system is shown in the diagram above.

Coal from the yard storage is delivered to a yard hopper and discharged by a Hafft feeder onto a belt that carries it to the plant roof where it enters one or the other of the two drying systems that operate in parallel. Coal is first scraped into a double paddle mixer that blends it with previously dried silt to facilitate drying. The blend is then discharged into a high-velocity (6,000 fpm) stream of hot flue gases supplied by either of two stoker-fired boilers in the old section of the plant. The gas stream carries the coal up through a drying tower to a cyclone separator drying it en route. About 7 sec is required for this. At the cyclone the dry coal is separated from the hot gases which pass out to the stack through a centrifugal blower.

Leaving the cyclone the dry coal passes through a rotary air lock to a "dry divider" that diverts part of it back to the mixer. The rest is discharged to bunkers and thence to pulverizers and furnace burners in the new boilers.

The amount of dry coal returned to the mixer for blending with incoming wet coal is controlled by an automatic cycle timer and thrustor-actuated damper in the dry divider that diverts the output of the cyclone to the mixer for adjustable intervals.

The percentage of time that cyclone output is diverted to the mixer depends on the moisture in the coal being dried. For example: 17% moisture coal requires discharge of dry coal to the mixer 20% of the time; 22-24% moisture coal requires discharge to the mixer half the time.

Flue gases for drying the wet silt can be withdrawn at a constant rate and 2,000 F from either or both of two stoker fired boilers in the old section of the plant. This hot gas is tempered to 1,200-1,400 F by mixing with cold air before it enters the drying tower.

Some Vital Statistics

LUZERNE COUNTY GAS & ELECTRIC SYSTEM

Service Area	315 sq mi
Total Meters	41,170
Load Factor (Annual)	63.6%
Peak Load (1 Hr Max. Gen.)	63,400 kw
Capacity	75,000 kw
No. Generating Station	2

HUNLOCK POWER STATION

	New	Existing
Initial Operation	1947	1925
Size Generator	20,000	20,000
No. & Size Boilers	2–175,000 lb/hr	3–55,000 lb/hr @ 100%
Steam Pressure	375 psi	360 psi
Steam Temperature	850 F	700 F
Type of Firing	Pulv.	Stoker
Fuel	Anth. Silt	Barley
Heat Value (Btu/lb)	11,400	10,950

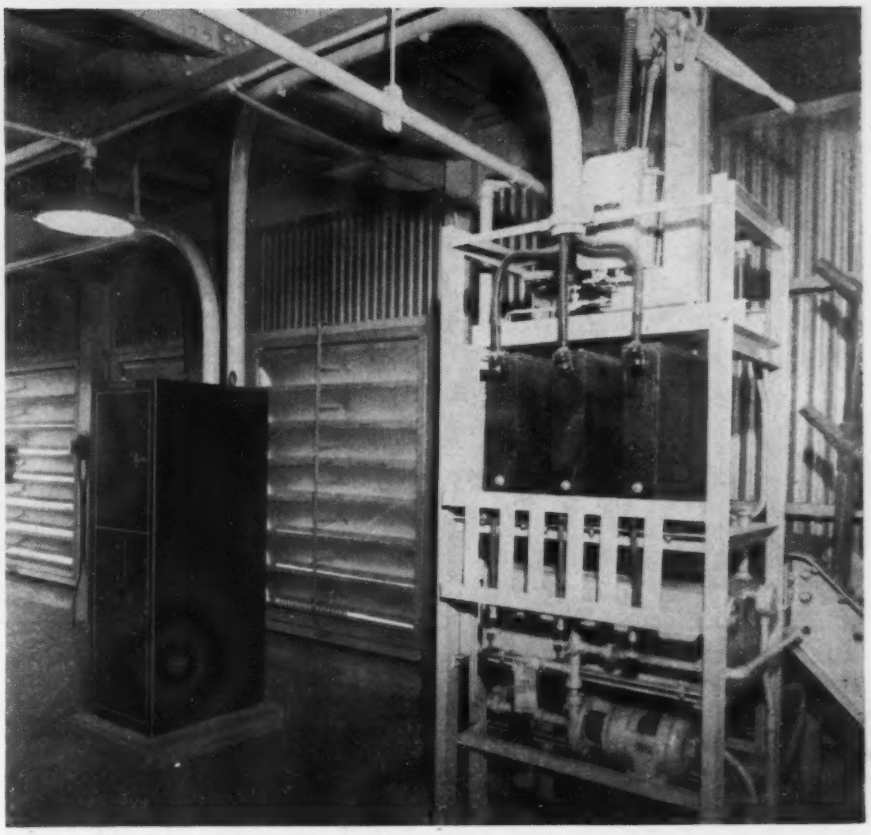
STATION PERFORMANCE

Gross Generation (Day)	840,000,000 kwhr
Peak (Max 1 hr)	45,000 kw
Btu/Kwhr (net)	19,000
Station Thermal eff	17%*
Plant Factor	70%

* Note: Low due to extraction of heat from boilers for the coal drying plant.

Fuel burned in the old boilers to produce gas for drying would generate the equivalent of 25,000 lb of steam per hr at 360 psi, 700 F. In other words about 100 lb of 10,950 Btu/lb Barley coal was burned in the old boilers to dry a ton of silt. This ratio experienced during the first six months of summer and winter operation is expected to be lowered as operators become more familiar with the equipment and the nature of the fuel.

For efficient generation of flue gas for drying, the old boilers must be operated above their minimum firing rates. Consequently, there is always a surplus of about 50,000 lb of steam per hr generated by the old boilers as a by-product of the drying operation. Consideration was given to using this steam in the turbine driving the 1,250-kva house generator and exhausting to atmosphere but this proved uneconomical. Use of this excess steam in the evaporators was also considered and rejected because steam needs were not great enough.



LIQUID SLIP REGULATOR in combination with wound rotor induction motor provides compact scheme for adjusting speed of ID fans. Short circuiting switch, at left, removes regulator from circuit in case of trouble; throws full voltage on motor

Surplus Steam Used

As the system is now operated, surplus 360 psi 700 F steam from the older boilers can be disposed of through either the old or the new turbo-generator. When the older turbine is operating, the surplus steam can be absorbed by it directly. But when this turbine is out of service excess steam is fed into the header supplying 375 psi, 850 F steam to the new turbine from the two new 175,000 lb per hr boilers. To do this, pressure on the header must be dropped 10-15 psi. Introduction of 50,000 lb per hr of 700 deg steam dilutes the quality of steam supplied to the new turbine slightly.

Generation of flue gases for drying in an oil-fired auxiliary furnace was considered but rejected as uneconomical. While radiation and combustion losses are higher at limited firing rates in the old boilers than they would be in an auxiliary furnace, the obvious economy of using excess steam for power generation offset this effect.

Operating Experience

Some operating problems were experienced with the coal drying system during the early months of its operation. However, most of these had their basis in the extreme weather of last December and January and have been largely overcome to date.

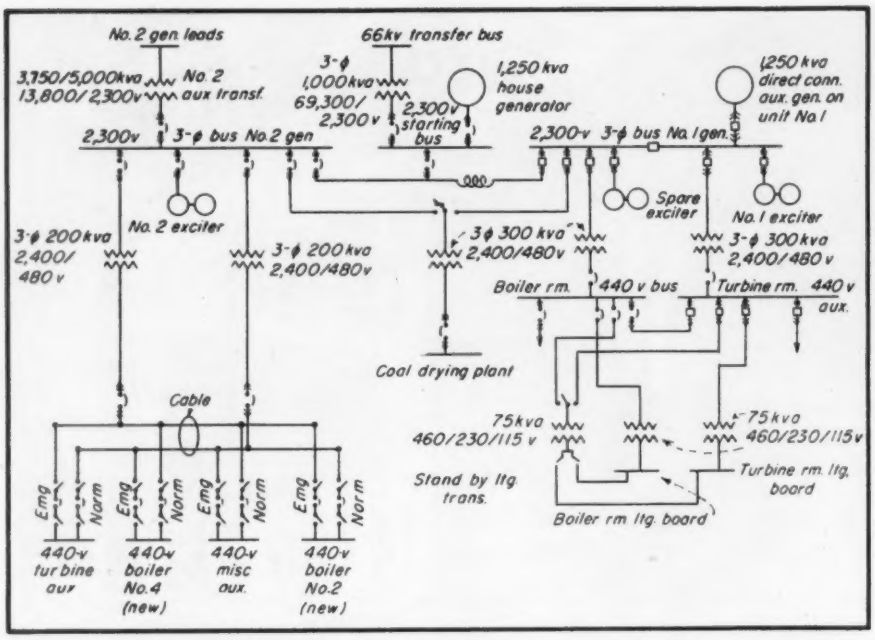
One of the early difficulties involved "frost balls" of ice and coal being rejected from the drying tower into the ash sluice because their weight was too great for the high-velocity gas column to support. Presence of the frost balls was due to the fact that when the plant first started silt was burned as fast as received from the colleries, since there was no stock pile in the plant yard to draw from. Thus the silt did not have an opportunity to drain and thaw during storage. The substantial storage of silt that has subsequently accumulated should eliminate this problem next winter.

Difficulty in maintaining the required 1,200-1,400 F gas temperature in the drying tower, particularly during severe winter weather, was another operating difficulty encountered. This was corrected when it was realized that the low temperature occurred in the morning when drying operations were started up after a night shut down. It was apparently due to heat lost in warming up the drying tower and ducts. To correct this condition longer hours of dryer operation will be maintained during cold weather.

Need for some sort of "scalping grizzly" or shaking screen over the yard hopper became evident when rocks, tramp iron and wood chunks entered the yard hopper and found their way into the paddle-type mixer with resulting damage to the paddles. Until a screen or "grizzly" can be installed extraneous refuse and lumps of coal are being picked by hand as it passes up the conveyor from the yard.

It was early learned that wet silt must be kept moving to avoid problems of arching and packing. While silt in the dry state will pass 80% through a $\frac{3}{4}$ in. mesh, only a small percentage will pass the same screen in the wet "as received" state due to its tendency to arch and pack.

The heaviest particles of unburned carbon and ash are collected where gases change direction in the furnace between the second and third pass; here they drop out by gravity. Second point of flyash removal is at the primary collector ahead of the in-



AUXILIARY SUPPLY SCHEME for new and existing sections of station. Separate 2,300-v auxiliary buses provided for each section. Either or both can be connected to "starting bus" that draws power from 1,000-kw transformer and 1,250-kw turbine-driven house generator

duced draft fan. Solids gathered at this point are directed to a secondary dust collector, the lighter particles are separated and returned by blower to the intake of the primary dust collector on their way to the stack.

Ash and free carbon that settled out in the furnace and was collected at the secondary collector is reinjected into the furnace under air pressure. Experiments are being made on one of the two boilers with injection of the flyash by gravity at a higher point in the furnace. It is believed turbulence and the greater distance to the furnace floor will improve combustion of the free carbon in the ash.

Speed adjustment on the induced draft fans on both new boilers is achieved with a liquid slip regulator and wound rotor induction motor.

Slip Regulator

The slip regulator is essentially a liquid rheostat with a straight line voltage characteristic that increases and decreases voltage applied to the rotor of the wound-rotor motor in accordance with demands of the automatic boiler control system. A liquid slip regulator was used in preference to a resistor since its more compact physical size would conserve space in the fan house atop the plant.

Essentially the regulator consists of a motor that alters the separation between specially-designed electrodes in a solution of sodium carbonate so achieving a rheostat with a straight-line characteristic. An 80% speed reduction from the full load speed of 702 rpm is attainable in the 350-hp 2,300-v fan motor.

Failure of the liquid slip regulator for any cause automatically actuates a switch that short circuits the terminals of the regulator imposing full voltage on the motor and bringing it to full speed immediately. Draft is then controlled manually by means of pneumatically operated dampers.

Turbine Arrangement

Hunlock Station was originally laid out for a total of seven 20,000-kw units. When the turbine room was built provision was made to house two 20,000-kw units in line although, only one was installed.

When the most recent extension was being laid out it was found that a modern 20,000-kw, 3,600-rpm hydrogen-cooled unit was enough shorter than an 1,800-rpm machine of the "20's" to allow installation crosswise of the turbine floor, if a separately driven exciter was used. Thus three 20,000-kw machines can ultimately be installed in the space originally intended for two.

The new 3,600-rpm generator is equipped for hydrogen cooling at 15 psi but will be operated initially at 0.5 psi unless the capacity situation requires the increased capacity permitted at the higher hydrogen pressure. Generator rating at 0.5 psi hydrogen is 20,000 kw, 0.8 power factor; at 15 psi rating is 23,000 kw, 0.8 power factor.

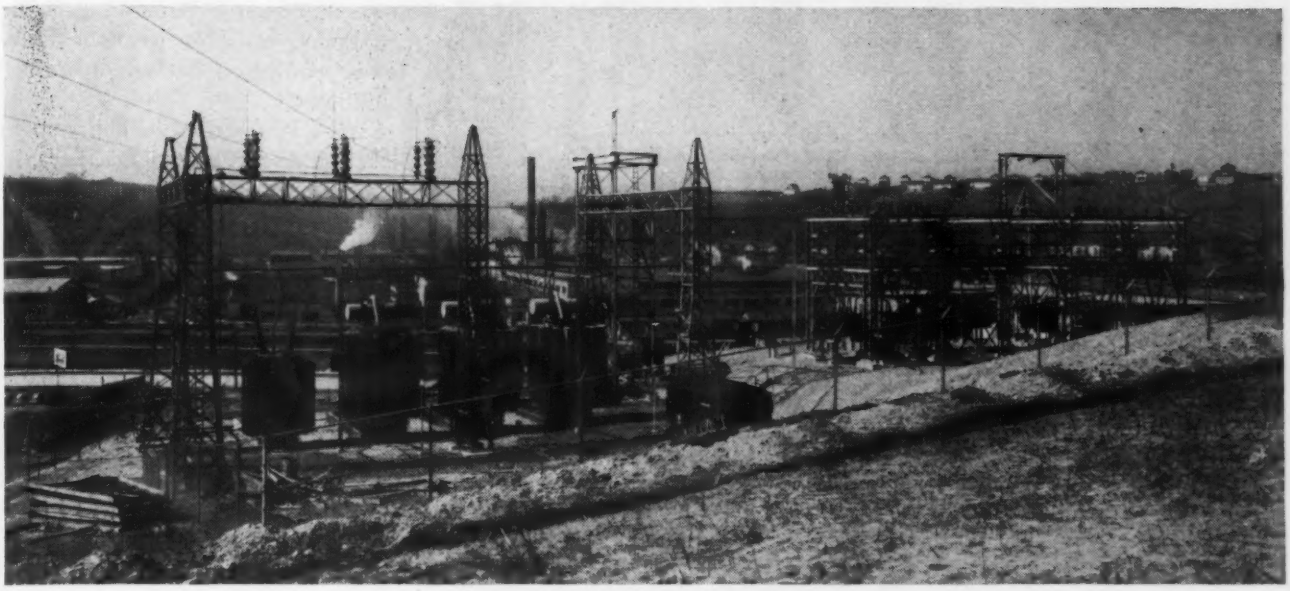
With the new unit crosswise of the turbine room, generator terminals were offset from the opening that had been provided in the plant wall to give access to an external cable tunnel. To reach the tunnel it was necessary to carry the generator leads along the station wall under the turbine floor in an area congested with piping and structural steel. Clearance for the leads was so restricted that it was decided to use metal-clad isolated phase construction up to the tunnel entrance.

Auxiliary Power Supply

All plant auxiliaries involving motors in excess of 50 hp are supplied at 2,300 v; those under 100 hp at 440 v. General arrangement of the auxiliary system in the old and new section of the plant is shown. Separate 2,300-v buses serve the principle boiler and turbine room auxiliaries of both main units. Auxiliary power supply for the new section of the plant originates from a 5,000-kva 13,800/2,300-v, three-phase forced-air-cooled transformer solidly connected to the leads of the new generator. A direct connected 1,250-kva auxiliary generator supplies power for the older section of the plant.

The 2,300-v buses of either or both units can be connected to a "starting bus" which, in an emergency, can draw power for station auxiliaries either from a 1,250-kva spare turbine-driven house generator or a 1,000-kva 69,000/2,300-v starting transformer located in the station yard and connected to the 66-kv transfer bus.

Power for 440-v auxiliaries in both the old and new section of the plant is stepped down from 2,300 v and distributed from dry type unit substations of which there are five in the station; two of 200-kva and three of 300-kva capacity. At the time the extension was made all oil-filled auxiliary transformers and most circuit breakers in the old section of the plant were replaced with dry type transformers and air type air circuit breakers. This change was made in order to eliminate the oil fire hazard within the plant.



STEEL MILL SUBSTATION supplied at 132 kv from incoming line at left, steps voltage down to 25 kv for distribution to plant

Increased Energy Supply For Steel Mill

PEAK DEMAND of Armco Steel Corp jumped from 25,000 to 37,000 kva when the plant installed a 60-ton electric arc furnace with a 12,000 kva transformer bank at Butler, Pa. last February. Preparations to handle the 50% increase, which equalled the preceding 10 years growth, requires substantial rearrangement of primary energy supply.

The revamped facilities embody new features in equipment, design, ownership and maintenance. These include:

1—Use of War Production Plant equipment and facilities modified to meet system requirements and scheduled delivery of energy.

2—Adoption of radial in preference to loop feeders.

3—Assembly of separately-owned facilities on power company property.

4—Use of high-capacity metering equipment with by-pass facilities.

5—Maintenance by one organization of separately-owned facilities.

6—Supervisory control economies.

7—Satisfactory flicker performance of 25 kv system.

Based on paper presented by the authors before recent meeting of Electrical Equipment Committee, Pennsylvania Electric Assn.

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For the past 22 years, or since 1926, Armco Steel Corp has been served over two separate-routed 25-kv, 500,000 cir mil copper circuits from West Penn Power Co's 132/25-kv Butler substation, about 3 miles away. These lines terminated within the plant in two 25/6.9-kv banks of three 5,000-kva transformers.

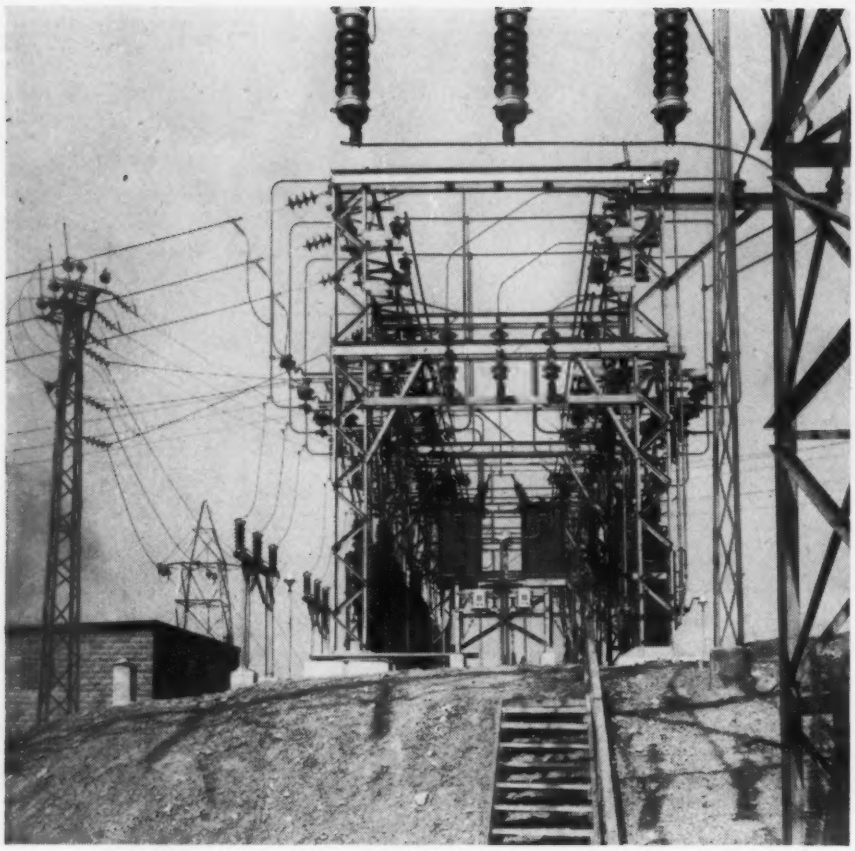
In 1947 when projected plant expansion called for more circuits and more transformer capacity, a site was selected that was traversed by both the 25-kv circuits near the steel mill. Its situation with respect to the steel mill was particularly advantageous. The elevation favored the use of long spans with good clearances and so permitted radial feeders to be extended over a highway, several railroad tracks and a number of plant buildings to almost any plant location.

Previous studies by the steel company, that were reviewed by West Penn engineers, sought to locate a substation site on the plant property. But, since expansion of the plant had to be in a longitudinal direction, because of property limitations, there was practically no space available within the plant for substations. The utility-owned site proved to be the best solution because of its proximity to and elevation above the plant.

Radial System Selected

Lack of space in the plant for substations to handle 25-kv loop feeders was a strong factor influencing selection of a radial type of power supply. Moreover, the radial supply had the advantage of confining the 25-kv oil breakers to the new "Bredinville" substation. This had a maintenance advantage and also made possible the use of a single switchboard instead of several switchboards which would have been required had loop stations been located on the plant property.

Armco's construction schedule called for prompt action by the power company. To meet it war surplus substation facilities were acquired that had been installed at a war production plant in Michigan. This included



25 KV SWITCHING STRUCTURE viewed end-on from 132 kv bay. Except for two 10-kva station lighting and power transformers in foreground apparatus left of centerline is customer owned; to right utility owned. All maintenance is done by utility. Control house contains separate switchboards for control of customer's and utility's apparatus

three 14,000 kva transformers complete with steel structures, air break switches, insulators, lightning arresters, flood lighting, fences, etc.

Some of the equipment required modification to suit their particular system needs. For example, the transformers, which were capable of carrying 21,650 kva each at 55 C with their attached fans operating, were provided with 15-kv side-outlet bushings for cable connection to indoor switchgear. Their windings, however, were suitable for 25-kv grounded-neutral operation. Accordingly, new tank tops were provided that allowed installation of 34.5 kv bushings and the addition of bushing-type current transformers on both high- and low-side bushings, to provide the necessary circuits for protection.

Energy supply to this new Bredinville substation is from West Penn's 132 kv system by way of a tap to one of the 132-kv lines from Springdale Power station to Butler Substation.

The lines dead-end on the 132 kv bay of the substation and are tied solidly to the primary of the delta-wye of the bank of three 14,000 kva 132/25 kv transformers. The 25-kv neutral is grounded through a 19 ohm outdoor resistor. A 2,000 amp 34.5 kv 1,000,000 kva pneumatic-operated oil breaker connects the transformer secondary to the 25-kv main bus.

Two 25 kv buses are provided, each sectionalized by a disconnect switch; the main or "West Penn bus", to which the transformer bank is connected, and the "Armco bus" from which all steel mill feeders take off. These two buses are connected through a 600/1,200/5 amp high-capacity outdoor metering unit which measures all energy supplied to the steel mill. This metering unit may, in case of emergency or for maintenance purposes, be by-passed by an air-break switch and removed from service with gang-operated rotary-type disconnect switches.

Two Tie Circuits

The two 25-k circuits that originally supplied the steel mill are retained and used as a tie between the 25-kv main substation bus and the power company's Butler substation bus. Energy may flow in either direction depending on load and operating conditions.

Early load distribution and voltage flicker studies indicated that because of the fluctuating nature of the electric furnace load, this steel mill load might have to be segregated from the company's 25 kv system—ie, operated with both the Butler No. 1 and No. 2 tie circuits open. However, operating experience to date has proven that the 25 kv network can remain closed.

Armco circuits No. 1 and 2, being the portion of the original circuits that extended on into the original 25-kv steel mill substation, are retained and controlled by breakers connected to different sections of the Armco bus. The furnace circuit is connected to and normally supplied from the transformer side of the Armco bus. An air-break switch, mounted on a separate steel structure, allows the furnace circuit to be transferred to the other bus section during maintenance. A spare breaker position is provided for an additional Armco circuit which is about to be extended to this station. The 125 v d-c energy for all control circuits is supplied from the power company's battery.

The 25 kv switching structure, shown in end view in an accompanying picture, has become standard for all West Penn 25-kv outdoor switching structures where circuit breakers are necessary. A number of bays and a considerable amount of switching equipment, tubing, insulators, lightning arresters etc. are kept in stock. This standard structure permits the use of a variety of switching arrangements. Each bay provides for the control of two 25-kv circuits.

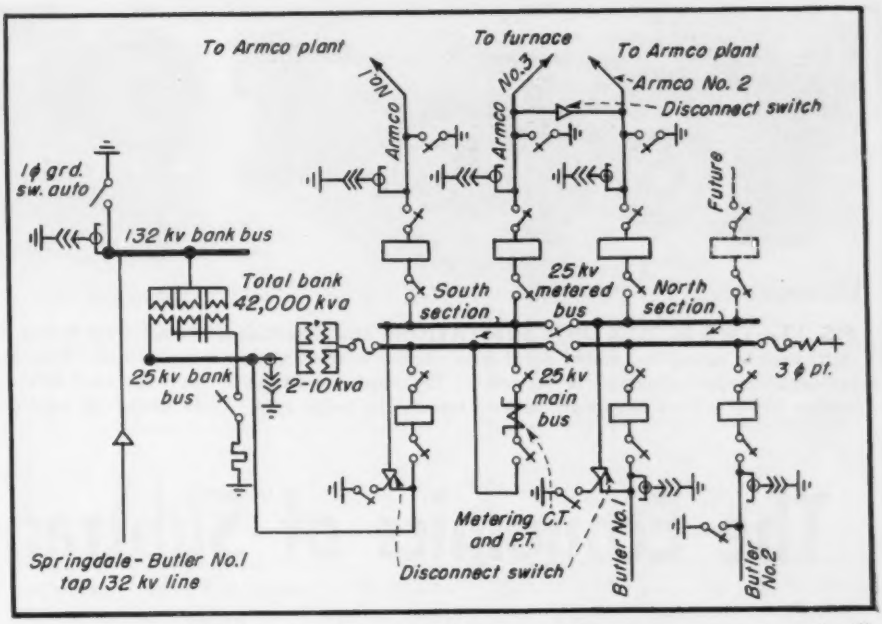
Joint Ownership Policy

This switching structure embodies the third main item of this story, namely, joint ownership. A switching structure such as the Bredinville installation may, depending on circumstances, be located on either the power company's or the customer's property. When erected on its own property as was the case at Bredinville, West Penn owns and maintains the entire steel structure. When installed on a customer's property West Penn owns and maintains the steel structure, but the customer supplies the foundations. This policy, adhered to in the present

instance, is governed by the fact that should a power contract be terminated, the utility may completely remove its facilities from the foundation and leave no investment.

At Bredinville, as at other similar substations, West Penn Power Co provides, erects and tests all control facilities including breakers, buses, disconnect switches, arresters, etc and bills the customer for the cost of all such facilities beyond load terminals of metering equipment. In accordance with general policy the metering terminals determine the division of ownership of control equipment. West Penn owns the metering equipment when only one is supplied, as was the case at hand. Customer ownership starts at the load terminals. At Bredinville, therefore, Armco owns all apparatus on the 25 kv structure that is on the load side of the metering unit and associated with the Armco bus.

Under an agreement with the customer all equipment both in the switch yard and the control house is maintained by the power company.



ELECTRICAL DIAGRAM of Bredinville substation supplying primary power to steel mill

Relaying and Protection

Relaying and supervisory control equipment at Bredinville Substation was designed to coordinate the requirements of the Power Company and the Steel Company.

1—132 KV PROTECTION RELAYING. The Bredinville 132-kv bank has no 132 kv breaker and it is necessary to trip the 25 kv breaker of the bank together with the 132-kv breakers at Butler and Springdale for bank or 132 kv line faults.

Phase comparison type carrier current relaying that provides ground fault protection only, is in service on the two Springdale-Butler 132 kv lines. This installation made a carrier current relaying terminal unnecessary at Bredinville since the bank is connected delta on the 132 kv side and star on the 25 kv side.

A 132-kv ground fault on Springdale-Butler No. 1 line and its extension up to the 132 kv bushings of the Bredinville bank will cause the tripping of the 132 kv breakers at Springdale and Butler by carrier current relaying. If the ground fault is temporary Springdale re-energizes the line. If the ground fault persists and the line remains energized from the delta-connected Bredinville bank, the operator at Butler Substation will by supervisory control, trip the Bredinville bank 25 kv breaker thereby de-energizing the 132 kv line.

A phase-to-phase fault occurring on the same extent of 132 kv line as the 132 kv ground fault described will trip the 132 kv breakers at Butler and Springdale through instantaneous or time overcurrent relays. Three directional overcurrent relays, connected to C.T.'s in the 25 kv bus side bushings of the Bredinville transformer bank 25 kv breaker will trip the transformer 25 kv breaker. If the 132 kv line is successfully energized, the transformer bank 25 kv breaker will automatically reclose in ten seconds.

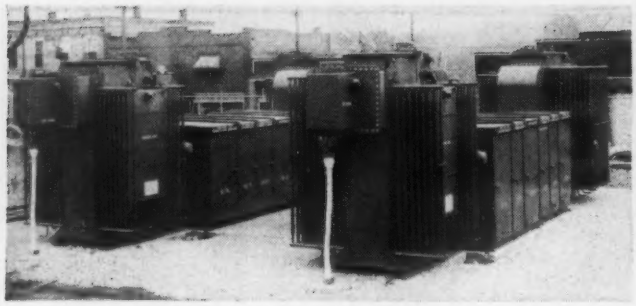
2—TRANSFORMER BANK PROTECTION. A bushing type C.T. is installed in each 132 kv bushing of the bank. Instantaneous over-current differential protection is provided for each of the 132 kv bank windings individually. The relays simultaneously trip the bank 25 kv breaker, the bank 132 kv airswitch and the 132 kv bank single pole 132 kv grounding switch. When this grounding switch closes, it grounds one phase of the 132 kv line and causes breakers of the 132 kv line to trip at Springdale and at Butler through the action of the carrier ground fault relaying.

A bushing C.T. is installed in each 25 kv bushing of the bank. Differentially connected overcurrent relays are connected between the C.T.'s of the 25 kv transformer bank breaker and the C.T.'s on the neutral side of the 25 kv bank windings. These differential relays perform the same tripping function as differential relays applied to the 132 kv winding of the bank.

3—25-KV BUS PROTECTION. The 25 kv main bus and the 25 kv metered bus are protected as a unit by a set of differentially-connected overcurrent relays and a directional ground relay. C.T.'s on the line side bushings of the six 25 kv breakers are used for this purpose. These relays operate a multi-contact tripping relay which trips all of the six 25 kv breakers. One test of the 25 kv bus is made by the transformer bank 25 kv breaker.

4—25-KV LINE PROTECTION. The two 25 kv lines extending to Butler have directional overcurrent phase and ground relays. The three 25 kv breakers extending to the Armco plant have non-directional overcurrent phase and directional ground relays.

5—SUPERVISORY CONTROL EQUIPMENT. Two distinct applications of supervisory control equipment are installed in this Butler-Bredinville-Armco coordinated operating area, both operated over leased telephone lines. One system known as the West Penn supervisory equipment extends from Bredinville Substation to Butler Substation where an attendant is always on duty. The other system, known as the Armco supervisory equipment extends from Bredinville Substation to the Armco plant.



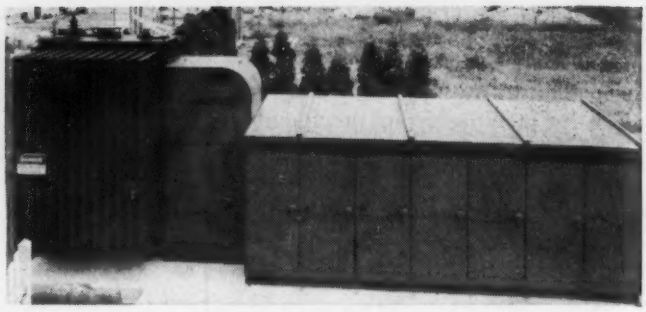


FIG 12—TWO DUPLEX UNIT SUBSTATIONS at one location (left) used to supply four radial distribution circuits in areas where individual feeder regulation is indicated. The master unit substation (right) is used in primary network system. Its single transformer often serves the same load as the two transformers of one duplex unit. Thus there are half as many transformers but twice as many sites with a primary network, and the ratio of area load to number of substation transformers may readily attain 2,500 kva

The Economics of Subtransmission—III

Economic variations in subtransmission system pattern imposed by distribution network systems. Observations concerning correlation of subtransmission and external source-systems

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IN the two preceding installments, (ELECTRICAL WORLD Sept 11 and 25), this analysis of subtransmission economics was limited to radial distribution. But the study would be incomplete without an examination of the economics of subtransmission systems that impinge upon distribution network systems.

VII—Variations with Distribution Networks. It can be shown that in general dual-voltage subtransmission using 13.8 kv on the low side is more attractive when distribution networks are used than when distribution is radial. No study can do justice to either primary or secondary network possibilities without considering the subtransmission and distribution systems jointly, and variations inside the distribution system are outside the scope of this study. Nevertheless, indicative analysis can be made about the subtransmission variations demanded by underlying networks.

(A) PRIMARY NETWORKS

1. *Distribution Substation Building Blocks.* Fig 12 (left) illustrates the duplex unit used in the radial distribution system analysis. For primary networks, this is replaced by the master unit substation of Fig 12 (right). In the network, the ratio of area load to number of substation transformers may readily attain 2,500 kva, instead of the 1,250 kva used in the radial system "duplex" building blocks. On this basis, the extra cost of the 34.5 over 13.8-kv primary network substation can be as low as 1250/2500 x $1.20 or 60¢ per kva rather than the $1.20 per kva of Fig 4, first installment. Such cost variations are, however, minor; the underlying primary network creates no important change in the comparative cost of 34.5 and 13.8-kv distribution substation building blocks.

2. *20-Mva Load Area Coverage* Eight network substations can be readily interlaced to serve a 20 Mva load. Fig 13 (a) reproduces the parallel pattern of Fig 5, second installment. This must be modified to something like Fig 13 (b) for primary networks. In this case, 21 miles (rather than 12 miles) of subtransmission circuit are used inside the load area. That increase is not significant, in this comparison of 13.8 kv and 34.5 kv, if overhead circuits are used. But it is if cable is required.

With 34.5-kv cable area coverage, the loop pattern (Fig 5, previous installment) was incorporated to obtain maximum economy at densities under 4,000 kva/per sq mi. This concept is not sound for underlying networks however, because:

(a) If eight primary network substations are used rather than four radial substations; the number and cost of loop breakers is doubled.

(b) Outage of a loop section can create more network load unbalance than outage of one of the four feeders of the parallel pattern.

All things considered, the 20-Mva cable area-coverage advantage of 13.8 over 34.5 kv for primary networks will often exceed the $3.50 per kva found with radial distribution.

3. *Distance Subtransmission.* If the modified parallel pattern (Fig 13b) is used with 34.5 kv, feeders No. 1 and 3, 2 and 4 cannot be tied together and each pair served with one distance subtransmission circuit from the source as they can with radial distribution (Fig 13a). If it were tried, a 34.5-kv fault would cause outage of two area feeders and loss of power to one-half of the primary network substations. However, the cost penalty of covering the distance from the source with four 34.5-kv feeders, each loaded to less than half capacity, must be avoided if pos-

sible. A switching station with suitable sectionalizing breakers, could be injected so that two 34.5-kv distance subtransmission circuits could supply the 20-Mva network. However, it might be better to couple the 20 Mva area with any nearby 20 Mva area and serve the resulting 40 Mva with either three or four interlaced feeders. Such additional coupling is not necessary for 13.8 kv. It creates a cost disadvantage for 34.5 kv.

(B) SECONDARY NETWORKS

Cable area coverage is generally required with secondary networks. Area coverage cost economies of 13.8 over 34.5 kv are far greater with secondary than with primary networks. Moreover, the average load per network transformer is so much less that the extra 34.5-kv voltage charge per installed transformer becomes quite an item.

With secondary networks, therefore, it is necessary to depart from the single-voltage 34.5-kv subtransmission system. Unless there are no sites for intermediate stations available it is necessary to:

(1) Use one of the dual-voltage systems stepping down to 13.8 kv or,

(2) Include half-step 34.5-kv high-side intermediate stations. These should generally step down to 13.8 kv with area coverage at 13.8 kv.

VIII—Rational Correlation of Subtransmission and External Source-Systems. Cost comparisons of ideal combinations of subtransmission and underlying radial distribution systems were developed in Section VI (previous installment). Single voltage 34.5-kv subtransmission quite definitely appeared economically sound over a wide variety of load and area conditions. This is probably quite broadly true even though, for any particular system, the quantitative evaluations will be materially modified by both (a) load growth considerations and other local peculiarities and (b) the additional costs of 34.5 kv with underlying networks.

So far, subtransmission has been artifically divorced from transmission and generation by the use of oversimplification. It has been assumed that all power could be made available to the subtransmission system at the *SAME* cost at *ALL* voltages. This, of course, is not necessarily true. Actual variations from this assumption can sometimes be greater than any subtransmission cost advantage of 34.5 kv. Therefore, it is impossible to make any overall observations concerning the correlation of subtransmission and external source systems without setting up case conditions which limit both subtransmission and source-system cost variations:

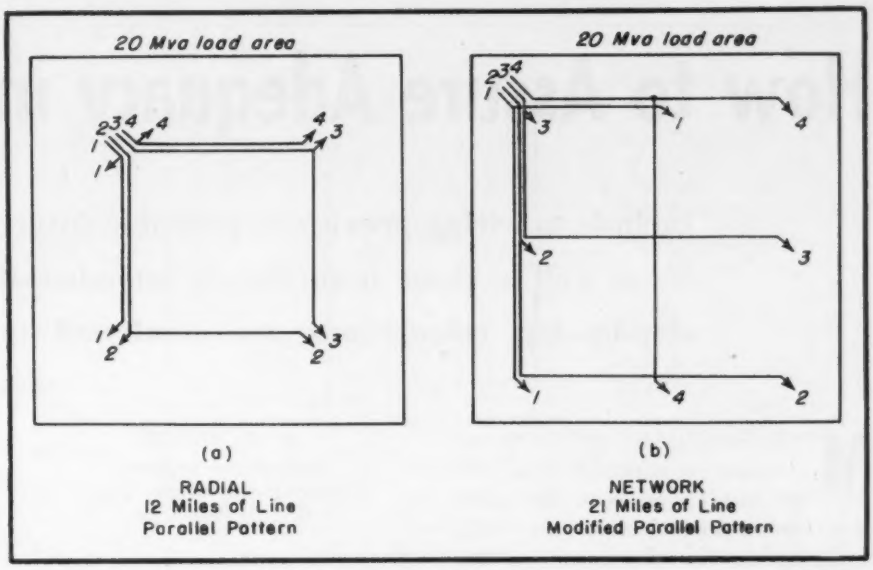

FIG 13—SUBTRANSMISSION CIRCUIT COVERAGE of 20 Mva load area (1,250 kva per sq. mi. load density) for (a) radial distribution system and (b) primary network distribution

(A) WHERE SUBTRANSMISSION DISTANCE CAN BE COVERED BY REASONABLY-DIRECT OVERHEAD CIRCUITS.

This classification eliminates the bigger metropolitan areas and those borderline cases where available overhead right-of-way is so round-about and costly that cable distance-subtransmission is competitive.

Case 1—Where the External Source is a Generating Station with The Primary Function of Serving a 50 to 100 MVA Load-Area No More Than 20 Miles Away.

This case may be dangerously isolationist from the standpoint of a long-range flexibility. However, it defines practical conditions that largely eliminate transformation up to and switching at a high transmission voltage.

The general solution very definitely favors single-voltage 34.5-kv subtransmission with integral generator and step-up transformers and the major generating station switching done at 34.5 kv. This observation is based first on the foregoing subtransmission analysis and second on the concept that:

(a) Unless the generating station is small (under 50 Mva) power can be made available at 34.5-kv about as economically as at 13.8 kv.

(b) Conversely, with a larger generating station, stepping power up to 69 kv or 138 kv, rather than 34.5 kv, brings no particular generating station saving until capacity becomes great enough (150 to 250 Mva) to create costly bottlenecks with 34.5-kv, 1.5 million-kva interrupting capacity breakers.

When a "moderate percentage" of the total load requires cable area-coverage overlaying distribution networks this 34.5-kv general solution may logically be modified to include half-step intermediate 34.5/13.8-kv stations. Where this "moderate percentage" becomes the major portion an exception to the general rule is encountered and dual voltage 69/13.8 kv is often best.

Case 2—Where the External Source is a 138-kv Transmission Station Located Centrally in an Area Having Less than 80 Mva of Load.

In this case power should be stepped down to 34.5 kv at the transmission station although several 20-Mva, 13.8-kv low-side building blocks might be used to serve any mouth-of-plant cable load areas. Coupling difficulties will generally prevent realization of any immediate economies with dual-voltage subtransmission although load growth may justify early extension of the 138 kv out into the load area to reinforce the system.

(*Continued on page* 171)

How to Assure Adequacy in Farm Wiring

Include in wiring provisions probable future uses of electricity as well as those immediately intended—Results of simple step-by-step calculations are combined into overall plan

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MOST LOGICAL METHOD of planning an adequate farm wiring installation is to deal with the determining factors for each building on the farmstead in the following order:

1. List all planned electrical loads for each building (present and in the foreseeable future) and determine their maximum demands.
2. Plan the number, size, and voltage of branch circuits required, including provisions for future needs.
3. Determine and locate control centers and building service entrances.
4. Plan the number and sizes of feeder circuits to control centers and the sizes of building service entrance conductors.
5. Plan the locations, arrangement, and sizes of feeders from meter pole to buildings.

Details of this procedure are disclosed by taking as an example a typical general farm with dairying as its major enterprise.

Wiring Calculations For House

The house on this farm has a single story and a basement. Outside dimensions are 32 x 50 ft. The basement measures 16 x 20 ft. Allowing 2 w per sq ft as suggested in the National Electric Code, the connected lighting load for 1920 sq ft is 3,840. 1,500 w are allowed for small appliance load. Present and future planned uses are shown in Table I.

Not all of this load would ever be operating at the same time. The Code allows certain deductions to be made in the capacity of wires in service entrances wire and feeders. A deduction of 70% is permissible from the total of lighting and small appliance load over 2,500 w. Lighting and small appliances amount to 5,340 w in this case. After applying the deduction, the calculated demand is 3,352 w for lighting and small appliances.

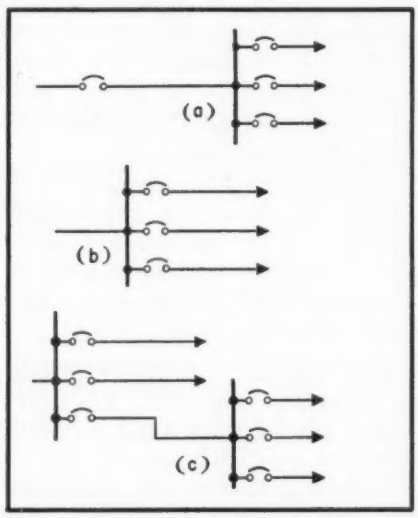

FIG 1—COMMON FEEDER Arrangement (a) used when equipment is grouped in a small area at some distance from service entrance. Individual circuits (b) are more practical if equipment is near service entrance. If equipment and uses are scattered, best arrangement may be single circuits (c) to large devices and feeders to branch points

When an electric range is supplied over the same service entrance wires that carry lighting and appliance loads the range can be considered as having a maximum demand of 8,000 w. Also if there are four or more fixed appliances in addition to the range supplied over the same service entrance feeder, a demand factor of 75% may be applied to these additional appliances to allow for diversity.

Diversity among the loads of the house has the greatest effect where all the loads are supplied over the single service feeder. Here all the deductions used in calculating the maximum demand for the entire house as shown in Table I can be used. Assuming a 3-wire, 115-230-v service feeder with the load properly balanced between the two legs, each live conductor must carry

$$14{,}952/230 = 65 \text{ amp}$$

From the wire tables, No. 4 conductors are required for a 70-amp service. In general, when electrical equipment is grouped in a small area at some distance from the service entrance, a common feeder arrangement is more economical and serviceable. If equipment is located near the service entrance individual branch circuits are probably more practical. In most cases, a combination of feeders supplying control centers and separate branch circuits from the service entrance for large equipment like water heaters and electric ranges gives the most flexible arrangement. (See Fig. 1.)

Feeders and Branches

Fig. 2 shows a tentative layout of feeders and branch circuits within the house. Separate feeders are run to the two control centers to take advantage of diversity among the individual loads and to provide more convenient means for controlling the branch circuits. The water heater and the range require individual branch circuits because of their heavier power requirements.

Lighting for the entire house, previously calculated to be 3,840-w connected load, is split between the two control centers with 2,000 w allotted to feeder. Small appliance load on each control center is given as 1,500 w according to requirements of the Code notwithstanding the allowance of only 1,500 w for this type of load for the entire building in

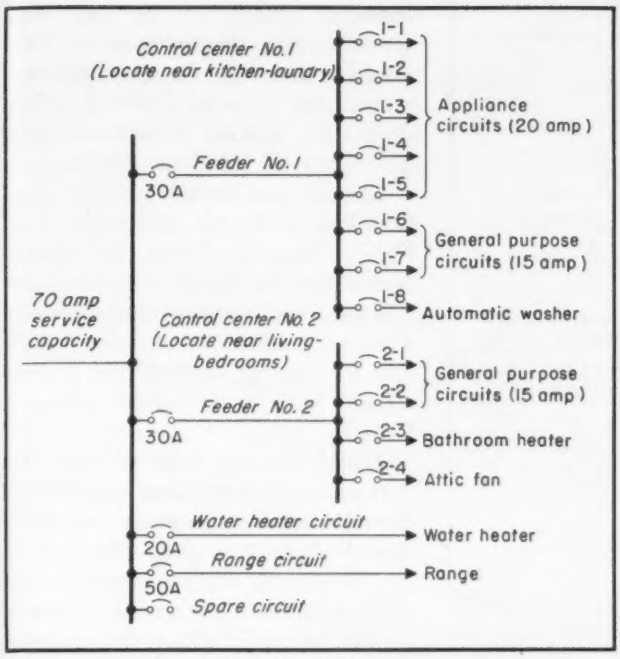

FIG 2—BETTER VOLTAGE CONDITIONS and greater flexibility are provided by arrangement of house wiring like this

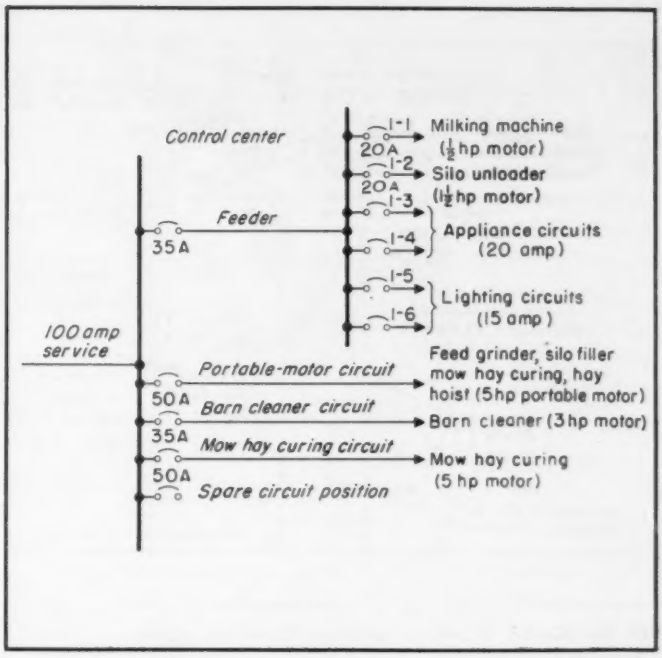

FIG 3—AMPLE CAPACITY for many years by this kind of barn wiring layout

calculating the size of service entrance conductors.

Circuits 1–1 through 1–5, Small Appliances	1,500 w	
Circuits 1–6 and 1–7, Lighting	2,000	
	3,500	
First	2,500 at 100% =	2,500
Remaining	1,000 at 30% =	300
Circuit 1–8, Automatic Washer		400
		3,200 w

With a 3-wire, 115–230-v feeder, the live legs must carry
3,200/230 = 13.9 amp

The smallest size of conductor allowed by the Code for feeders is No. 10 so there is ample capacity for the load requirements. No. 10 conductor can carry 30 amp. This allows the use of a 30-amp, 2-pole breaker which is larger than any breaker in the control center thus giving proper selective circuit protection.

The second feeder is calculated:

Circuits 2–1 and 2–2, Lighting	1,840	
Small Appliances	1,500	
	3,340	
First	2,500 at 100% =	2,500
Remaining	840 at 30% =	252
Circuit 2–3, Bathroom Heater		1,000
Circuit 2–4, Attic Fan		400
		4,152 w

At 3-wire, 115–230-v $\frac{4,152}{230}$ = 18.0 amp

No. 10 conductor is minimum size allowed. A 30-amp, 2-pole breaker gives proper selective protection.

No diversity can be allowed on branch circuits for water heater and range since each circuit supplies a single unit.

The water heater circuit (3,000 w at 230 v) requires 13.0 amp. Although No. 14 conductor can carry the load, No. 12 is recommended for better voltage. This requires a 2-pole, 20-amp breaker.

Range circuit (11,000 w—Demand 8,000 w at 230 v) requires 34.8-amp No. 8 conductor and a No. 10 neutral is indicated. The circuit should be protected with a 50-amp, 2-pole breaker.

Table II lists present and future planned uses for the barn and estimates how much of the equipment might be used simultaneously at any one time in each of the four seasons of the year.

Wattage for lights and portable devices such as clippers or portable insect sprayer, shown on the first line of the table is made up from an actual sum of the wattages of all lamps and portable devices. Loads taken by motors are determined from tables published in the National Electric Code.

Note that one 5-hp motor is listed under "Present Planned Uses" for

TABLE I—Farm House Connected Load and Maximum Demand

	Connected Load Watts	Calculated Maximum Demand Watts
PRESENT PLAN USES		
Lights		
First Floor 32 x 50 = 1,600 sq ft		
Basement 16 x 20 = 320 sq ft		
1,920 sq ft		
At 2 watts per sq ft	3,840	
Small Appliances (from Code)	1,500	
Sub Total	5,340	3,352 (1)
Range	11,000	8,000 (2)
FUTURE PLANNED USES		
Water Heater	3,000	
Automatic Washer	400	
Bathroom Heater	1,000	
Attic Fan	400	
Sub Total	4,800	3,600 (3)
Totals	21,140	14,952

(1) First 2,500 of 5,340 at 100%, remainder of 2,840 at 30%
(2) Allowed maximum demand of range supplied through service entrance with lighting and small appliances
(3) Demand factor of 75% allowed on 4 or more fixed appliances in addition to a range

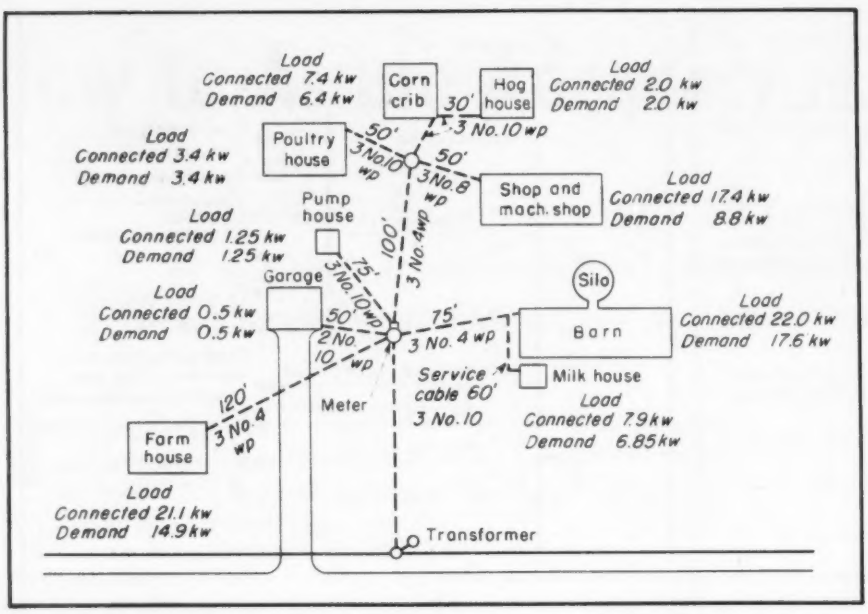

FIG 4—SCALE PLAN of farmstead facilitates planning of feeder runs from meter pole to buildings

use on four machines. Later, a separate 5-hp motor will be used for mow hay curing alone. Thus this use is listed twice for the one connected load.

The total connected load for both present and future uses amounts to 22,050 w. Not all of this equipment will be operated at the same time so it will be unnecessary to provide conductor capacity for the entire connected load. Wire sizes are determined from the largest probable load—called probable maximum demand—that will occur at any one time.

The time when the greatest load at the barn is likely to occur would probably be during the summer months when the hay curing motor is in operation at the same time that feed is being ground. Since other chores may be performed during this time, the barn cleaner has been listed because it is the largest other load. The silo unloader and the milker would normally not be in operation at the same time as the barn cleaner.

Since the combination of uses during the summer months adds up to the largest total (17,600 w) this value is taken as the probable maximum demand in determining entrance equipment and figuring feeder service to the barn. However, the National Electrical Code requires that feeders serving one or more motors be large enough to handle the full load currents of all of the motors including 125% of the full load current of the largest motor. This would increase the demand load current of the barn by 1,600 w (25% of 6,400) making a total demand of 17,600 + 1,600 or 19,200 w.

Feeders and branch circuits have been laid out for the barn as shown in Fig 3. As in the house, the control center for the lighting circuits, appliances, and smaller motors makes a more flexible arrangement than that of running each of the branch circuits back to the service entrance location.

The ability of a wire to carry the current is the first check to make in choosing wire size; equally important is a check on the voltage drop based on the length of the circuit. For good practice in wiring, feeders should be designed so that voltage drop does not exceed 2% of the nominal supply voltage. Voltage drop should be held to a minimum of 1% for circuits serving poultry brooders, incubators, or other equipment on which life processes depend.

The size of wire, considering voltage drop, can readily be determined from the following formula which is accurate within practical limits and distances encountered in farm wiring.

$$\text{Circular Mils (cm)}^* = \frac{22 \times \text{amp} \times \text{circuit length (one way) in feet}}{\text{drop in volts}}$$

If the wire size determined is different from the wire size required to carry the current in amperes, then the larger of the two sizes should be used.

At 3-wire, 115–230-v, 19,200-w demand equals 83.5 amp, requiring No. 2 conductor (100-amp service).

The feeder calculation is:

Circuit No. 1-1 (½ hp motor—milking machine)	850 w
Circuit No. 1-2 (1½ hp motor—silo unloader)	2,600
125% of 2,100	
Circuits Nos. 1-3, 1-4 (appliances and ventilation)	900
Circuits Nos. 1-5, 1-6 (lighting)	1,000
	5,350 w

At 3-wire, 115–230 v, 5,350 w equals 23.2 amp, requiring No. 10 conductor. This size is ample in regard to voltage drop because with length of circuit 50 feet and allowing 2% voltage drop,

$$\left(\frac{22 \times 23.2 \times 50}{4.6} = 5{,}560 \text{ cm}\right)$$

No. 12 conductor would be sufficient.

TABLE II—Connected Load and Probable Maximum Demand of Barn

Electrical Equipment Uses	Connected Load Watts	Practical Combinations of Use By Seasons (Load in Watts)			
		Spring	Summer	Fall	Winter
PRESENT PLANNED USES					
Lights and Portable Devices	1,500	500	500	800	800
Milking Machine ½ hp Motor	850				
Feed Grinder 5 hp Motor	6,400	6,400	6,400	6,400	6,400
Hay Hoist	(same motor)				
Mow Hay Curing	(same motor)				
Silo Filler	(same motor)				
FUTURE PLANNED USES					
Barn Cleaner 3 hp motor	3,990	3,900	3,900	3,900	3,900
Silo Unloader 1½ hp motor	2,100				
Mow Hay Curing (separate motor)	6,400		6,400		
Stock Tank Heater	500				500
Ventilation	400	400	400	400	400
Total	22,050	11,200	17,600	11,500	12,000
Plus 25% demand largest motor 6,400 x .25			1,600		
			19,200		

* Circular mils can be converted to wire size by referring to tables of allowable carrying capacities of conductors in the National Electrical Code.

Use No. 10 conductor with 35 amp, 2-pole breaker.

The portable motor circuit is figured to carry 38 amp (full load amperes of motor at 230 v = 28 amp; 125% of 28 amp = 35 amp). At 2-wire, 230 v, No. 8 conductor is required to carry the load. But with length of circuit to farthest outlet 135 feet and allowing 2% voltage drop,

$$\left(\frac{22 \times 35 \times 135}{4.6} = 22{,}600 \text{ cm}\right)$$

No. 6 conductor is needed. Therefore, use No. 6 conductor with 50-amp, 2-pole breaker.

Similar calculations show that No. 8 conductor with a 35-amp, 2-pole breaker is required for the barn cleaner motor circuit and No. 6 conductor with 50-amp, 2-pole breaker is required for the mow hay curing motor circuit.

Wiring For Other Farm Buildings

The milk house and other farm buildings are dealt with in similar manner to determine the connected load and probable demand. In the cases of the poultry house, hog house, pump house and garage, it is probable that all of the uses in each building will be on at one time so the demand is considered the same as the connected load.

Table III lists present and future planned uses for the various buildings and the connected loads, probable maximum demands, current requirements, lengths of feeders and sizes of feeders to each building as shown in Fig 4.

The layout in Fig 4 is typical of many farmsteads. It illustrates how these procedures of wiring planning apply to any farm. Since in this case the farmstead is quite near the highway, the transformer can be located on the highway pole as shown. Pole metering has certain advantages: (1) The size of the feeders from the meter pole to the various buildings will be smaller than for any other meter location. (2) If it ever becomes necessary to change the service equipment in one building, the wiring at other buildings need not be disturbed. (3) Loss of one building by fire or storm will not interrupt service to other buildings. (4) It is very desirable to have the water system on a separate service direct from the meter. This is generally more easily accomplished from a centrally-located metering pole.

If two buildings are quite near each other it may be best to serve the second building by service cable or wires extending from the first, instead of running lines from the distribution poles. This has been done here for the milk house and hog house.

TABLE III

	Appliance Connected Load Watts	Appliance Probable Demand Watts	Building Connected Load Watts	Building Maximum Demand Watts	Current Requirement Amps	WP Feeders to Buildings Length	WP Feeders to Buildings Size
HOUSE (See Table I)			21,140	14,952	65	120	4
BARN (See Table II)			25,050	19,200			
Plus ½ Milk House demand on same service				3,425			
				22,625	98.5	75	4
MILK HOUSE							
Present Planned Uses:							
Lights and Portable Devices	400	400					
Milk Cooler (½ hp motor)	850	850					
Water Heater	2,500	2,500					
Ventilation	100	100					
Future Planned Uses:							
Churn (¼ hp motor)	530						
Cream Separator (¼ hp motor)	530						
Unit Heater	3,000	3,000					
(Cable from barn to serve milk house)			7,910	6,850	29.8	60	10
FARM SHOP AND MACHINE SHED							
Present Planned Uses:							
Lights and Portable Devices (battery charger, paint sprayer, etc)	1,000	800					
Bench Saw (½ hp motor)	850						
Drill Press (¾ hp motor)	530						
Utility Motor (½ hp motor)	585						
Wood Saw (5 hp motor) 6400 x 1.25 for demand	6,400	8,000					
Future Planned Uses:							
Welder	8,000						
(Smallest conductor recommended)			17,365	8,800	38.2	50	8
POULTRY HOUSE							
Present Planned Uses:							
Lights	200						
Brooders, 2 units	2,000	all uses					
Water Warmers	300						
Ventilation	100						
Heating Cable for Water Pipes	800						
(Allowance for 1% voltage drop)			3,400	3,400	14.8	50	10
CORN CRIB							
Present Planned Uses:							
Lights and Portable Devices	1,000						
Future Planned Uses:							
Corn Drying (5 hp motor) 6400 x 1.25 for demand	6,400	8,000					
			7,400	8,000			
Plus ½ hog house demand on same service				1,000			
				9,000	39	40	10
HOG HOUSE							
Present Planned Uses:							
Lights and Portable Devices (brooders, heaters, sun lamps, etc)	2,000	all uses 2,000					
(Smallest conductor allowed by Code)			2,000	2,000	8.7	30	10
PUMP HOUSE							
Present Planned Uses:							
Lights and Portable Devices	400	all					
Water System (½ hp motor)	850	uses					
(Smallest conductor allowed by Code)			1,250	1,250	5.5	75	10
GARAGE							
Present Planned Uses:							
Lights and Portable Devices (battery charger, trouble light, etc)	500	all uses					
(Smallest conductor allowed by Code)			500	500	4.5	50	10*
SUB-FEEDER (Meter Pole to Second Pole) Demand equals all of Farm Shop plus ½ of Poultry House, Corn Crib and Hog House				14,700	64	100	4

* All services are 3-wire 115/230 volt except Garage which is 2-wire 115 volt.

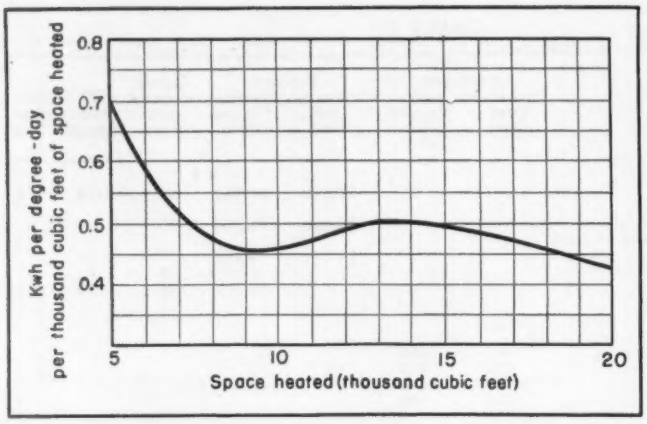

FIG 1—AVERAGE ENERGY REQUIREMENTS per degree day per 1,000 cu ft of space heated

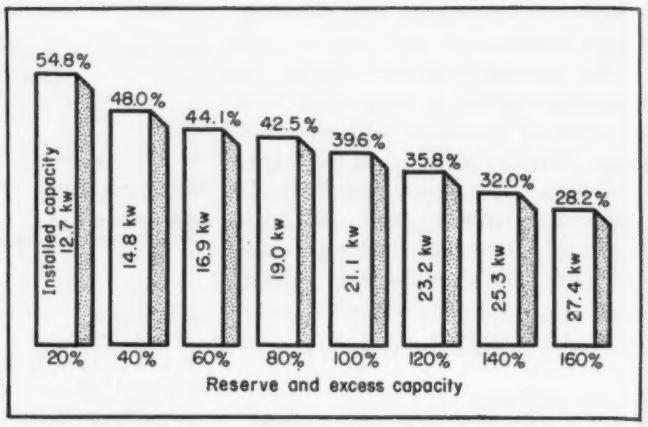

FIG 2—INDIVIDUAL CUSTOMER LOAD FACTORS for average 10,000 cu ft house in a month of 900 degree-days

House Heating Experience

Utility must see to it that heating installations are competently engineered. Otherwise investment to serve and cost to customers will be needlessly high

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Budget Engineer
Electric Power Board of Chattanooga

UNIT REVENUE from individual house heating installations on the system of the Electric Power Board, Chattanooga, Tenn, can be as much as 7.5 mills. It can be as little as 4 mills. These are figures from the residential rate schedule. The rate has 5 steps—50 kwhrs at 3¢, 150 @ 2¢, 200 @ 1¢, 1000 @ 4 mills, over 1400 @ 7.5 mills. Many customers with all electric homes consume over 1400 kwhr per month for general household use. These customers pay a straight 7.5 mills for their heating requirements. Other customers who use less than 1,400 kwhr per month are able to purchase some energy for heating at 4 mills. As a general rule the smaller customer who converts to electric heating can purchase up to 700 or 800 kwhr per month at the 4 mill rate. Actually, an average unit revenue of 6.16 mills can be expected from the heating load of the average-insulated 10,000 cu ft house over the heating season Sept-May (Table 1). This customer's heating bill is about $90.61 per season.

If the house is exceptionally well insulated the customer will use fewer kilowatt-hours, more if it is poorly insulated. Because of variations in insulation, the season's heating cost may be reduced 15% or increased up to 20%. These figures are for a house with unit heaters. They would not be greatly different for a furnace-type installation, assuming equality in conditions of application and operation.

Based on a 69-yr weather record, the average degree days per year in Chattanooga are 3,200. On the Power Board lines there were about 2,200 house heating customers during the past heating season. The average connected heating load per customer was 15 kw, and is now declining as more smaller houses are connected. Probably it will stablize somewhere between 12 and 15 kw.

An analysis of direct job order costs of adding 362 house heating customers in the fall of 1946 (Table 2) shows the average total cost per customer as $226 and the average per kw connected as $14.25. From the

TABLE I
Monthly Heating Costs, 10,000-Cu Ft House 600 Kwhr per Month Used for other Services

Month	Kwhr	Cost	Cost per kwhr Mills
Sept.	60	0.24	4.0
Oct.	620	2.48	4.0
Nov.	1,985	12.09	6.1
Dec.	3,140	20.75	6.6
Jan.	3,300	21.95	6.65
Feb.	2,720	17.60	6.48
Mar.	1,920	11.60	6.04
Apr.	790	3.16	4.0
May	185	0.74	4.0
	14,720	90.61	6.16

TABLE II
Analysis of Costs of Adding House Heating Customers (Direct Job Order Costs)

362 Customers—5,750 Kw	Average Customer
Line & Service Cap. Increase	$65.00
Line & Service—Oper. & Mtce	8.60
Transformers	110.50
Meters	43.00
Cost of Removal	2.00
Salvage	4.50 Cr.
Transportation (Costs from clearing accounts)	1.40
Average Cost Per Customer	$226.00
Average Cost Per kw Heating Load Connected	14.25
Average kw Heating Load Per Customer (Connected)	15.87 Kw

trends since then, in general cost levels and in sizes of heating customers connected, the average cost of adding a heating customer now is probably close to $250 and of adding a kilowatt of heating load around $20.

In January, 1948, energy sales to residential customers were 10.9 million kwhr higher than in October, 1947. Revenue from these customers was $76,700 higher. Unit revenue from the sales increase was 7.05 mills. Unit cost of purchased power from TVA, plus energy loss, was 3.75 mills. This leaves 3.3 mills to cover operating expenses and fixed charges.

Low Margin Business

It is apparent from the foregoing figures that in the rate and other conditions of electric service in Chattanooga, house heating is narrow margin business at best. It is apparent also from experience in Chattanooga that as people become acquainted with the values and conveniences of electric house heating, they will demand it more and more, and cost to them or to the serving utility is rapidly declining in significance as a deterring factor in growth of the heating load.

For these reasons it is of utmost importance to the customer and the utility that house heating be vigorously controlled in respect to its application. To let it grow haphazardly is to invite trouble and expense from high demands and low load factors, and to allow cost to customers to rise much higher than is necessary.

There are two aspects of electric heating application in which control is imperative. One is the weather insulation of the house. Under even the most benign conditions of rates and supply, to heat a house with electricity is the most expensive method. Electricity is a refined and costly "fuel." The heat from it costs more per unit than the heat from almost any other source. More care must be taken to prevent it from being wasted to the outer air. These are obvious considerations. They require in an electrically-heated house much more effective weather insulation than is usual.

The details of the second aspect are not so obvious. The electric heating installation must be competently engineered. The amount of engineering data so far accumulated in this field is still comparatively small. But it is enough to prove that customary methods for calculating combustion heating requirements do not apply to electric heating.

TABLE III—Energy Requirements for Heating Houses of Different Sizes, Chattanooga, Tenn.

House Sizes Cu Ft	Kwhr per Deg Day Unit Heaters	Kwhr per Deg Day Central Furnaces	Kwhr per Deg Day per 1,000 Cu Ft Unit Heaters	Kwhr per Deg Day per 1,000 Cu Ft Central Furnaces	Annual Kwhr per Cu Ft Unit Heaters
5,000	3.5	4.0	0.70	0.80	2.2
6,500	3.6	4.3	0.55	0.66	1.8
7,500	3.7	4.6	0.49	0.61	1.6
10,000	4.6	6.0	0.46	0.60	1.5
13,500	6.8	9.0	0.50	0.67	1.6
20,000	8.6	11.0	0.43	0.55	1.4

Electric heat is much more efficiently applied than is heat from burning fuel. The electric unit heater almost completely eliminates heat distribution losses. And the furnace-type heater can be so located in the house as to reduce these losses to a minimum. In a fuel-burning installation allowance has to be made for these losses. Allowance has to be made also for neglect of cleaning and maintenance in combustion heating, but not in electric. All through a combustion heating calculation are margins, factors, and allowances which are not needed when electric heat is used.

Failure to eliminate from or to minimize these allowances in calculations results in an electrical installation unnecessarily large for the duty required of it. Such failure may result in heating capacity surplus of 40–140% as against the 10–20% for a furnace-type installation and the 20–25% for unit heaters which experience has shown are ample for reserve capacity.

Excess Capacity Is Costly

Surplus capacity beyond desirable reserve adds to cost to both user and utility. The user pays more for equipment than is necessary. Because of more abrupt surges in heat production as compared with even temperature maintained by a properly designed installation, operating devices are subject to greater wear, with resulting shortened life.

To the utility excess heating capacity is a costly burden. It adds to system investment and increases production expense. In the coldest month of the year in Chattanooga (900 deg days), the average house of 10,000 cu ft will establish a maximum demand of 12.5 kw if the heating installation is properly designed. If this house has 120% excess capacity, the nominal maximum demand would be 18.5 kw, but in adverse weather conditions it could rise to 23 kw, for which the utility must provide supply facilities. The utility's fixed cost for this customer is much higher than it need be.

Operating Practice Important

Another matter of great importance to the utility is the manner in which the customer operates his heating installation. Many operating practices most favorable from the customers' standpoint are also most favorable to the utility. Customer benefits (with no appreciable increase in kilowatt-hour consumption) justify the retention of a greater part of the "building heat" during all 24 hours of the day. Nighttime practice can provide for curtailment or complete elimination of all heating in the bedrooms if desired, but for the other parts of the house the best practice is to maintain temperature through the night not more than 8 deg lower than in the day.

To turn off the heat at night or to push the temperature control way down means that heat recovery in the morning will push the demand up. All heaters or the entire furnace may operate until the air temperature rises to 72 deg. The recovery period for the building, however, extends longer than the time required to heat the air. In many instances it extends throughout the entire morning and during this time the demand is greater than otherwise would be required.

Thus in respect of cost to serve the load and of customer satisfaction, the utility has a large stake in the proper design and operation of the customer's heating installation.

Most attempts to compare the re-

TABLE IV
Average Capacity Requirements For Houses of Different Sizes Chattanooga, Tenn.

Space Heated	Kw Capacity (25% Reserve)	Watts per Cu Ft (25% Reserve)
5,000	10.0	2.0
6,500	10.2	1.6
7,500	10.6	1.4
10,000	13.1	1.3
13,500	19.5	1.4
20,000	24.6	1.2

sults of unit heater installations with central furnaces will be definitely misleading. Many home owners who install central furnaces are not concerned with the cost of operation. They would rather install additional capacity to compensate for losses in ducts, cold basements and uninsulated walls than to eliminate them by installing proper insulation. These owners also tend to disregard the operating losses that could be controlled. The result is that they have a higher than average energy use and heating cost. In some instances the central furnace installations use as much as 35% more energy than the average house of the same living space. The owners who install unit heaters tend to be more economically minded and try more to limit their heating bills than those who install central furnaces. But for identical houses with identical heat losses and with occupants equally economy-minded, the energy consumed will be almost equal for the two.

Heating Cost Factors

Heating energy requirements vary with house size, but not in any smoothly inverse proportion, as might be expected (Table 3, Fig 1). Kwhr usage declines as house size increases from 5,000 to about 9,000 cu ft, then the curve rises and does not begin to fall again until the house of about 13,500 cu ft is reached. This vagary in the curve is the result of factors that tend to vary the heat requirements for certain size houses. The physical characteristics of the small house—the relationship of exposed wall area and the number of windows and doors to the total volume of space heated—are factors that make heat requirements per cubic foot change as the size of the house increases. In addition, even though owners of various size houses are not equally concerned about economizing on their heating costs, there is a tendency for owners of houses in a certain size group to economize more than do the owners of the houses in the other groups.

Though not so pronounced, the same vagary appears in the relationship between house size and watts per cubic foot (Table 4). Here again, there is an apparent low point in the curve for houses of around 10,000 cu ft.

Variations in capacity requirements for houses of equal size are almost always small. They are small partly because houses built for, or converted to, electric heat, are better constructed and better maintained than the average house and partly because heat losses are generally reduced before electric heat is installed. With a limited amount of preparation for electric heat the house is confined to a narrower range in the heat loss classification grouping than before it was so prepared. Energy requirements for electrically heated homes cannot begin to approach the variations usual with fuel burning equipment. Fuel requirements of combustion-heated houses cover a wide range because of the variation in effective use of potential heat in the fuel and the excessive radiation and distribution losses. These variations are almost entirely eliminated in electrically heated homes.

Average monthly load factors of house heating loads vary from a low of about 10% to a high of 55, the highest occurring, of course, in the coldest months. Individual customers whose installations have minimum reserve capacity, less than 20%, will have load factors higher than 55%.

Size of house, manner of operation, and insulation have some effect on load factor, but the largest determinant is amount of reserve capacity installed (Table 5). This relationship between reserve capacity and load factor is the strongest argument for utility insistence on proper engineering of house heating installations.

Many characteristics of the heating load are favorable. If the utility has a large domestic cooking load, this substantially contributes to the evening peak. The offhand assumption has been that space heating would be added to the cooking loads for these

TABLE V
Average Annual Load Factor 10,000 Cu Ft House 600 kwhr/mo General Household Use, Chattanooga, Tenn.

Reserve Capacity %	Annual Load Factor %
20	21
40	19
60	17
80	16
100	15
120	14
140	12
160	11

peak hours. Observations now indicate that the heating load is not added to the other evening peaks but that the previous domestic peaks become a part of the heating load. It appears that after a very short time lag the heating load automatically is reduced by the build up of the cooking and lighting loads. It is, therefore, evident that the individual heating systems are relieved of the demand for heat to the extent that heat is produced by other general household uses. The effect of this characteristic is that the domestic demand curve for the evening period tends to level out as it is increased by new heating loads.

Electrical Heating More Costly

We are now reaching the point in Chattanooga where electricity is becoming a competitor of other fuels—especially when we consider costs of operating the heating system, such as home cleaning. Except in a few instances the cost, on a fuel basis only, is still greater for electricity than for coal or fuel oil. The initial cost of conversion plus operating costs of 7 or 7½ mills kwhr will not permit use of resistance type heaters by all customers. Some other solution will eventually appear. In the meantime many utilities in the TVA area are accepting the new heating customers who beg to be connected to their lines. In Chattanooga our system load characteristics and power costs resulting from the added heating load are more favorable than we expected. We are building a load that if properly managed may prove one of our greatest assets during a depression period. The residential demand is more stable than the commercial and industrial. Added residential sales to those who can afford to pay should therefore help to stabilize total sales during a depression period.

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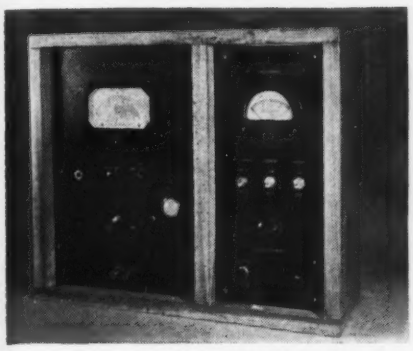

FIG. 1—**GENERATOR** (right) and voltmeter (left) are mounted in combination

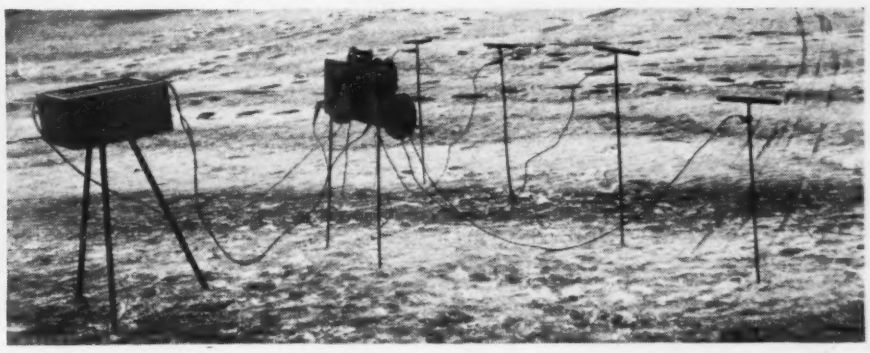

FIG. 2—**ELECTRODE** arrangement for measurement of ground resistance. Equipment includes generator-voltmeter combination, terminal board and electrodes

Geophysical Measurements Determined by Electrode Probing

J. R. LESLIE
Research Engineer
Hydro-Electric Power Commission of Ontario
Toronto, Canada

GRAVEL SURVEYS by the Hydro-Electric Power Commission of Ontario, and the search for low resistivity areas for good grounding in the vicinity of stations, transmission lines, etc., are expedited through the use of the electrical resistivity apparatus shown in Fig 1 and Fig 2.

The equipment (Fig 1) consists of a low-frequency generator (right) and a voltmeter (left). The generator consists of a motor-driven reversing switch running from a 22½-v battery. In Fig 2 the same equipment is mounted on a tripod. The vertical panel unit is a combination terminal board and carries four spools of wire for electrode connections.

Battery Power Supply

The apparatus generates 20-cycle square-topped waves from a dry battery supply and transmits the current I to the ground through the outer two electrodes (Fig 2). Voltage drop V across the inner electrodes is measured by a battery-operated vacuum tube voltmeter. For an equal spacing a between the four electrodes, the apparent resistivity R of the material between them to a depth a is given by the formula $R = 2\pi a V/I$.

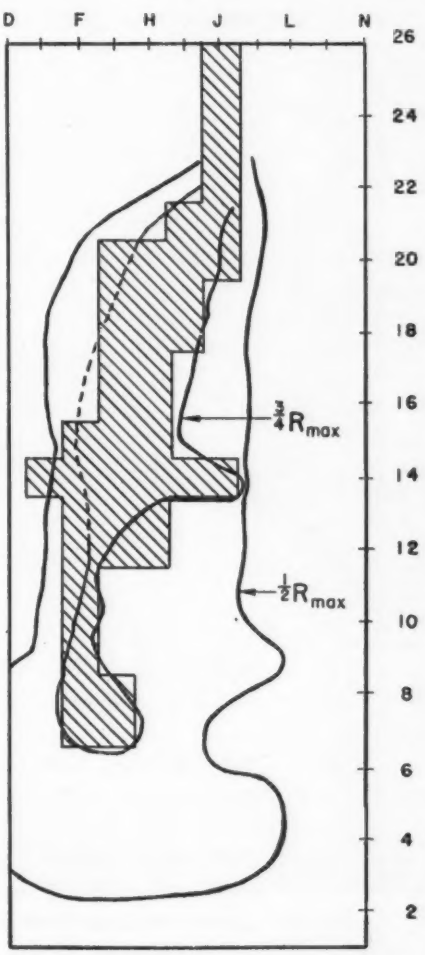

FIG. 3—**TYPICAL** iso-resistivity map, with cross-hatched region indicating gravel area. The highest resistivity found is designated R_{max}

Depth of material included in the measurement is approximately equal to the spacing a, for that reason four or more values of the latter are frequently used at each measuring station (eg 10, 20, 30, 40, 50 ft) to obtain the change in resistivity with depth.

In searching for gravel deposits, the area is first surveyed with the apparatus shown to determine the resistance of the earth at many points. These results are plotted and the points of equal resistance joined to form equi-resistivity contours. Regions of highest resistivity may represent solid rock or gravel and the regions of lowest resistivity may represent clay or organic material. A summary of resistivities encountered in surveys to date is shown in the table.

Ground Resistance Varies

The resistivity values for any material cannot be accurately specified because of their dependence on the amount of water and of water-soluble salts present, to name just two of the many variables likely to be encountered. However, it has been found that the resistivities follow the order given in the table irrespective of their absolute value in any one locality. A few test pits in the area are there-

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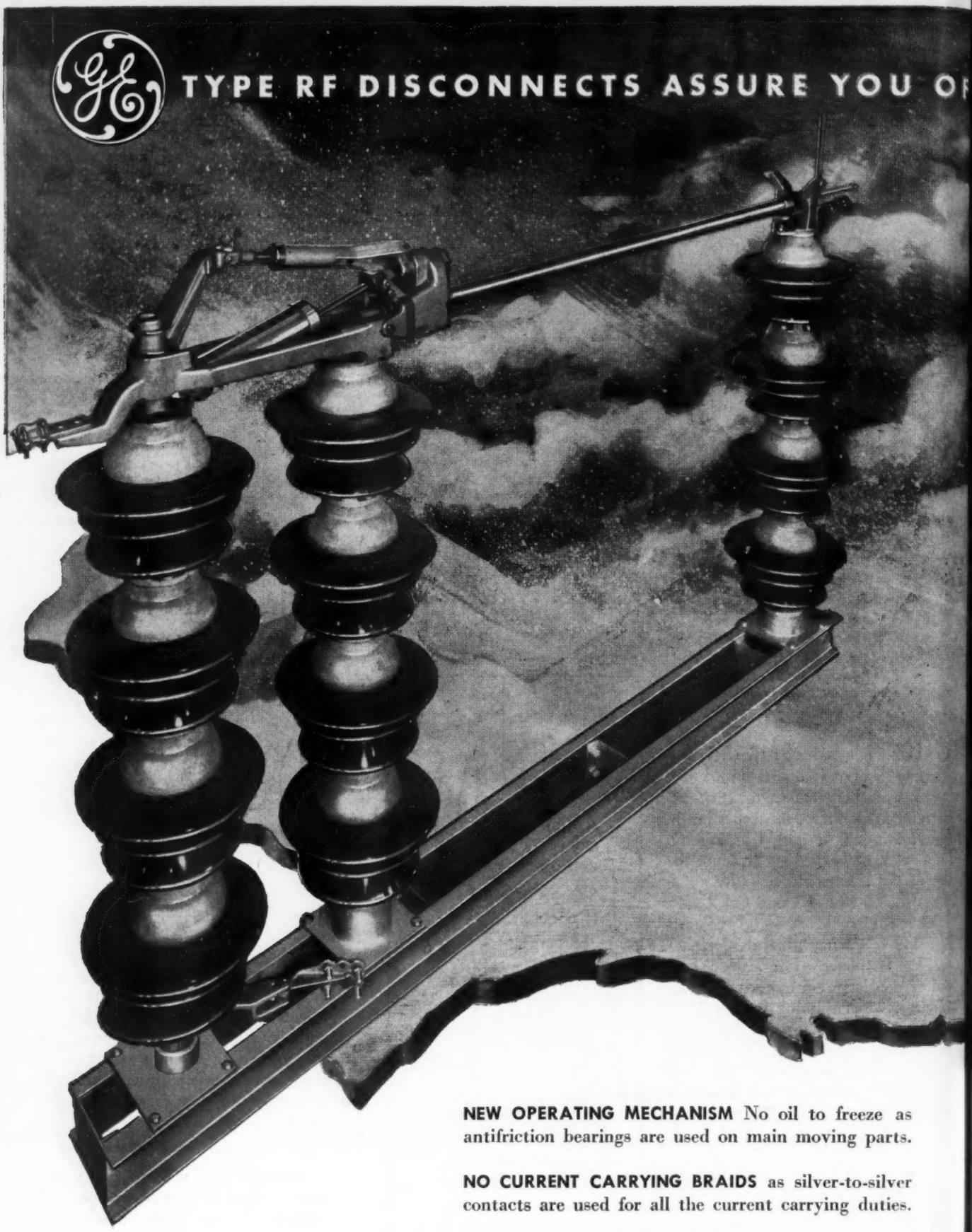

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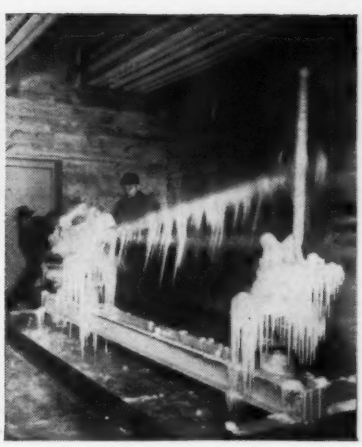

Blade slashes down to closed position

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fore necessary in order to interpret the readings.

Fig 3 shows the results of a geophysical survey for gravel in Eastern Ontario. Contours for $\frac{3}{4}$ R_{max} and $\frac{1}{2}$ R_{max} are shown, where R_{max} is the highest resistivity measured in the immediate area. The proven gravel area, obtained with test pits, is represented by the cross-hatched area. The agreement with the more expensive test pit method is satisfactory.

Typical Values of Earth Resistivities in ohm-feet.

Rock	20,000 and up
Gravel	20,000 to 60,000
Sand	10,000 to 30,000
Dry Soil	3,000
Clay	100 to 1,000
Moist Soil	300
Organic Moist Soil	30

Developed originally for gravel surveys, the instrument has been applied to predetermine the resistance of ground electrodes in the vicinity of power lines and stations. In areas where topsoil is high in resistivity, this method may detect underlying soil of lower resistivity, and indicate what length of rod is required to reach it.

Service Restoration Used at Three Loop Stations

W. M. EVANS*
Duquesne Light Co
Pittsburgh, Pa

THERE ARE 42 installations of service-restoring equipment on the Duquesne Light Company system at present with an additional 25 installations proposed and in various stages of planning. The function of these installations, in general, is to sectionalize permanently-faulted lines so that the fault may be isolated and service restored to all substations concerned.

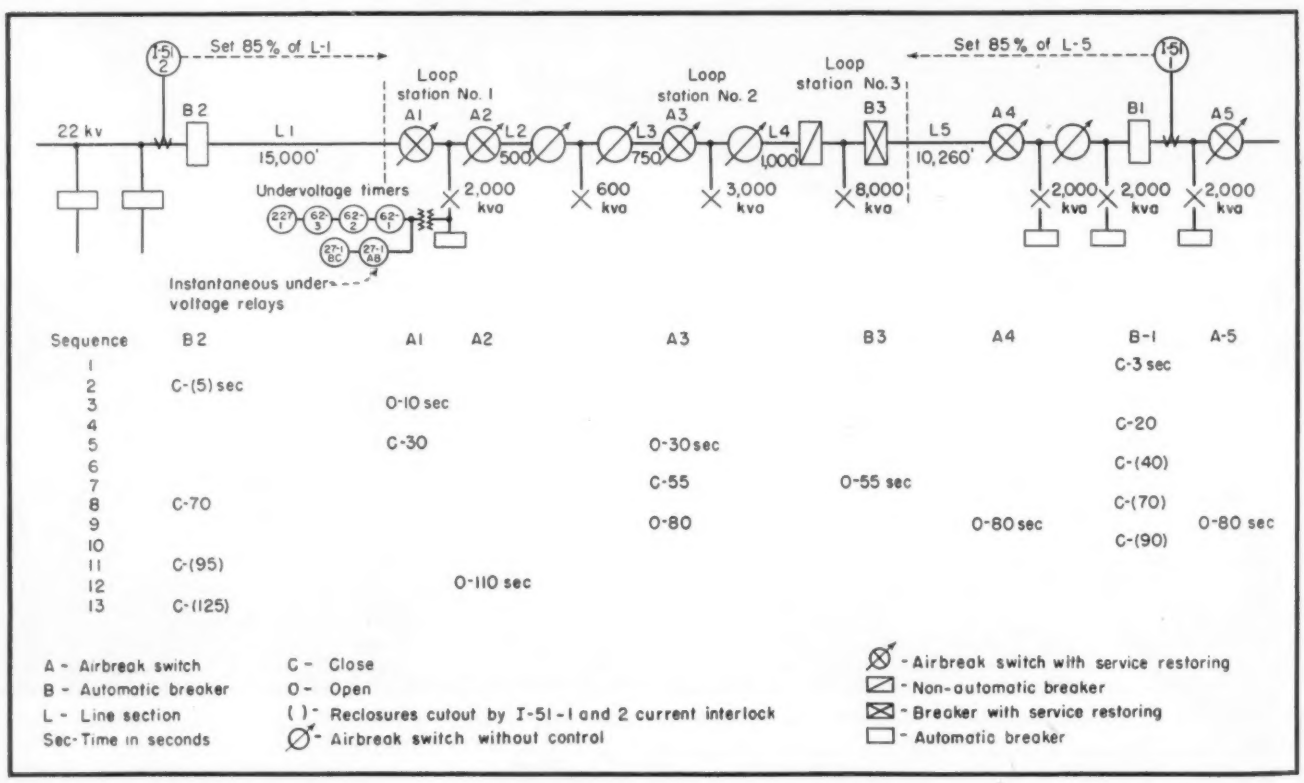
The company's first attempt to apply service restoring control to as many as three loop stations in series in one 22 kv transmission line section is described in the following.

These loop stations are provided with either d-c motor-operated airbreak switches or non-automatic circuit breakers equipped for operation when the station is deenergized. Service restoring control used on such airbreak switches or breakers is in general designed to coordinate with two automatic circuit breakers. These are located at terminal substations and are equipped with the necessary reclosing relays for coordination.

Undervoltage instantaneous relays are used for voltage detection and to initiate undervoltage timers at a predetermined drop-out voltage. The undervoltage timers are deenergized immediately by this operation. They then continue to perform the timing function at zero volts even under single phase transmission conditions.

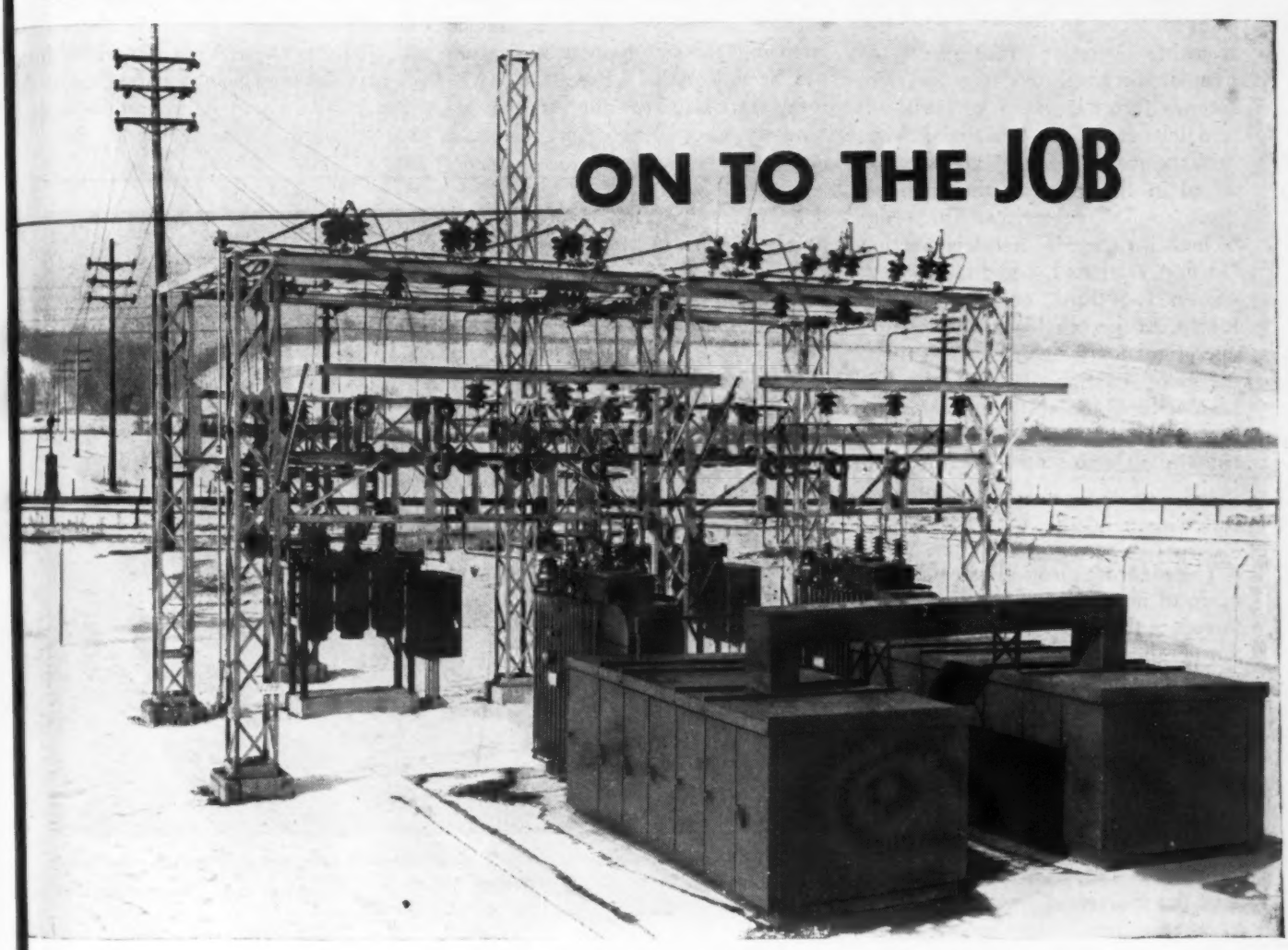
The general layout of the three loop stations is shown in the accompanying sketch which also shows other data on the control features. The line involved is 5¼ miles long. It is terminated at one end in an attended station and at the other in a full-automatic station equipped with capacity restoring control for transformers. Two of the three loop sta-

* An abstract of a paper presented by the author before the Relay Subcommittee of the Pennsylvania Electric Association, June 17, 1948.



SERVICE RESTORING SCHEME applied to three loop stations in series on five-mile transmission line. Line sections are sectionalized automatically in order from left to right. Sequence of breaks and switch operations is shown by relay time settings for one complete operation

Substation . . .



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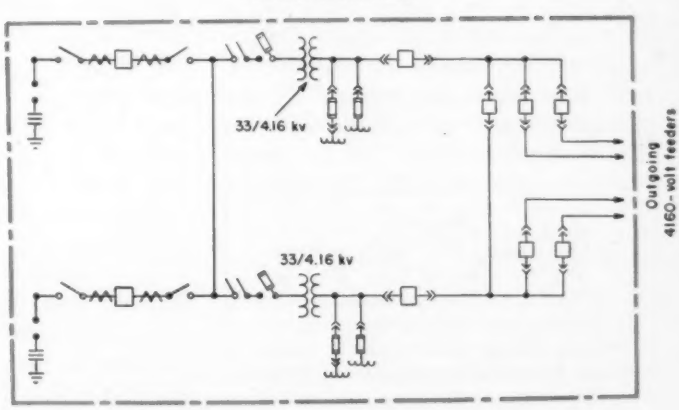

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tions have sectionalizing on one end only. The third has sectionalizing control on both ends.

Relay time settings are given on the sketch and indicate the sequence of operations in case a permanent fault requires the complete set of operations for isolation. Before any service-restoring operations take place, the line is energized in three and five seconds (after initiation of fault) alternately from the two ends. After this, permanent faults are sectionalized in the order of the line sections number subscripts. The order of fault isolation is, therefore, section L-1 first, sections L-2 and L-3 second, section L-4 third, and section L-5 fourth. At the conclusion of isolation operations for the respective sections, the major portion of the service has been restored to the stations equipped for automatic sectionalizing. This is true in all cases except permanent faults on bus or in line section L-4.

Relays Reduce Reclosures

The diagram also indicates the use made of instantaneous current relays to reduce the number of reclosures of the automatic breakers for faults at the terminals of these breakers, or for faults in adjacent line sections for a distance approximately 85% of the section. By this means the number of reclosures is reduced from four to one at B_2 and from five to three at B_1.

Control schemes used at the sectionalizing stations were designed to meet the individual requirements for automatic operation of undervoltage timing relays. For instance, the scheme used for control of switches A_1 and A_2 uses three undervoltage timers for control and one for remote indication if service is not restored. All four timers are initiated by two instantaneous undervoltage relays set to drop out at 190 v. The first timer opens A_1, the second closes A_1 and the third opens A_2.

Controllers were provided for manual operation of the airbreak switches. Automatic lockout of the service restoring features is part of the manual control to permit manual switching without interference from the service restoring control. Remote indication has been installed between all three loop stations and one of the attended stations. Note that airbreak switch A_3 and breaker B_3 are used to restore service to two stations.

To date no permanent faults or false operations have been experienced on this installation. However, other service restoring installations have been in successful operation for about 15 years. In this interval, trouble has been experienced with control schemes using current detection relays where coordination was required with other relaying.

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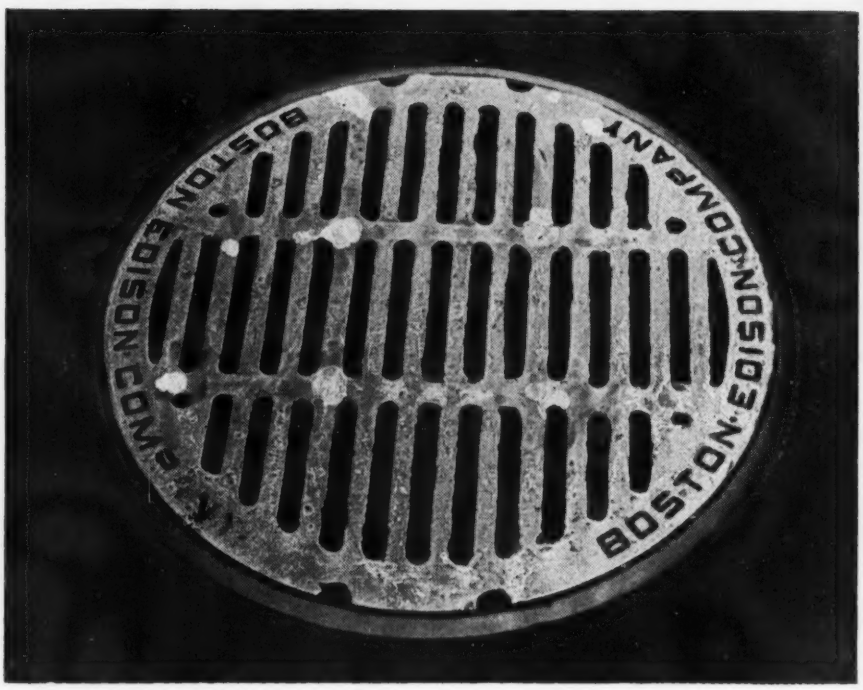

GRILL-TYPE of manhole cover with 40% of surface area open and 25% weight reduction as developed for Boston Edison anti-explosion service

Cover Design to Help Free Manholes of Gases

AS THE AFTERMATH of a number of recent explosions, the Boston Edison Co is installing a new type of manhole cover. The outstanding improvement is the utilization of 37 slotted openings in place of the former five 1-in. holes for gas venting.

The new type of cover weighs 187 lb whereas the old cast-iron cover weighed about 250 lb each. Overall diameter is 30 in. The slots are $\frac{3}{4}$ in. wide, and lie in three parallel rows. Slot lengths vary from $5\frac{1}{4}$ to $7\frac{1}{4}$ in. The slot depths are in general $1\frac{1}{4}$ in., except where a rib extends below this distance. Four $\frac{3}{4}$-in. round holes are also provided in the cover, and there are four semi-circular lips located in pairs to facilitate lifting.

In these covers, which have been subjected to various tests by the United States Bureau of Mines and the Massachusetts Institute of Technology, the ventilating orifices constitute 40% of the cover area. They are designed to withstand the weight of the heaviest trucks or other motor vehicles. Over 300 have been installed, and 15 to 20 are being added daily. The downtown area is being initially equipped. The new manhole covers are flat while the older type was convex $\frac{1}{2}$ in. above street.

Studies of the explosions, which occurred most frequently during the recent severe winter, have indicated the importance of minimizing possible accumulation of combustible gas. The new cover and other explosion prevention measures are experimental.

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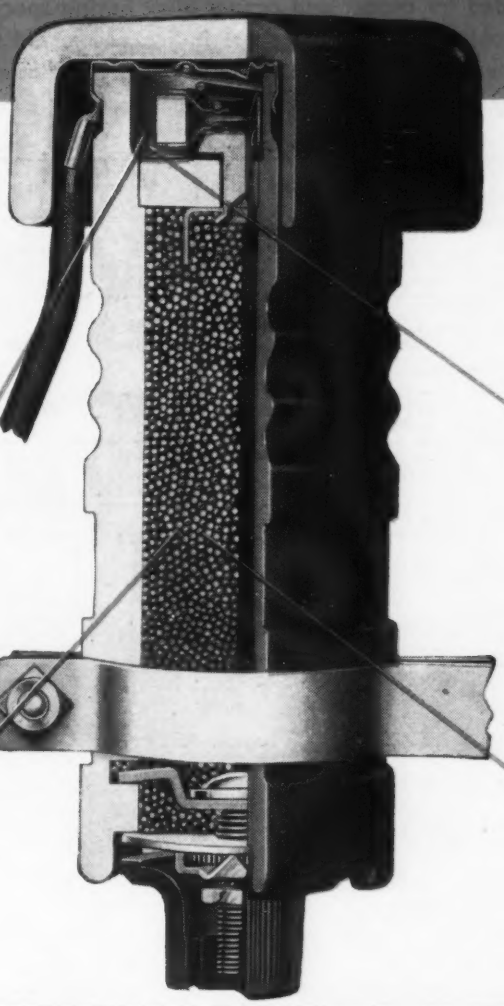

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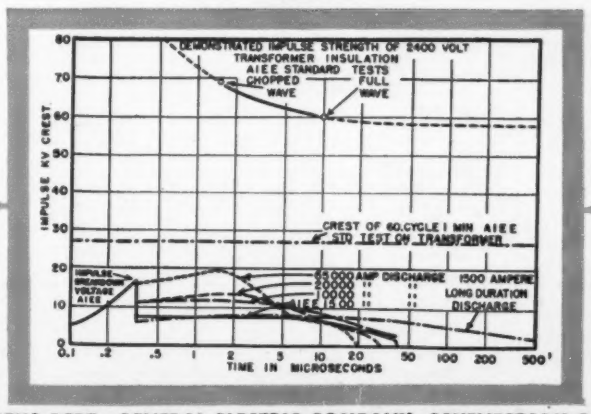
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Electrical Conductivity and Resistivity Of Copper Conductors

Data are provided for copper and copper alloy having specific gravity 8.89. The values established as standard are indicated in bold face type; other values given are calculated. . . Table is an adaptation from advance pages for forthcoming 8th edition of Standard Handbook for Electrical Engineers

Specification†	Temper and shape	Size limits, in.	Conductivity at 20 C (68 F), IACS, %	Mass resistivity at 20 C (68 F)		Volume resistivity at 20 C (68 F)			
				Ohms (m, g)	Ohms (mile, lb)	Ohms (mil, ft)	Ohms (m, mm²)	Microhm-cm	Microhm-in.
.....	.....	.....	100.17	0.15302‡	873.75	10.354	.017213	1.7213	0.67767
B4-42 B5-43 B170-47 B187-47T B188-47T	Low-resistance Lake wirebar Electrolytic wirebar Oxygen-free wirebar Soft bus bar, rod and shape Soft bus tube	All	100.00	**0.15328**§	875.20	10.371	.017241	1.7241	0.67879
B49-41 B3-45	Hot-rolled rod Soft, round	1.375–0.250 All	100.00	0.15328	**875.20**	10.371	.017241	1.7241	0.67879
.....	.....	.....	99.50	0.15405	879.60	10.423	.017328	1.7328	0.68220
.....	.....	.....	99.00	0.15482	884.04	10.476	.017416	1.7416	0.68565
.....	.....	.....	98.50	0.15561	888.53	10.529	.017504	1.7504	0.68913
B187-47T	Hard bus bar, rod and shape	Over 1 in. OD Over 0.375 × 4	98.40	**0.15577**	889.44	10.540	.017522	1.7522	0.68984
B188-47T	Hard bus tube, rectangular or square	Over 6 in.							
B48-45	Soft rectangular	All	98.16	0.15614	**891.58**	10.565	.017564	1.7564	0.69150
.....	.....	.....	98.00	0.15640	893.06	10.583	.017593	1.7593	0.69265
B188-47T	Hard bus tube, rectangular or square	Up to 6 × $\frac{3}{16}$ in. wall	97.80	**0.15673**	894.92	10.605	.017630	1.7630	0.69409
B2-47 B33-46	Medium hard, round Tinned soft, round	0.460–0.325 0.460–0.290	97.66	0.15694	**896.15**	10.619	.017654	1.7654	0.69504
.....	.....	.....	97.50	0.15721	897.64	10.637	.017683	1.7683	0.69620
B187-47T	Hard bus bar and rod	Up to 1 in. OD Up to 0.375 × 4							
B188-47T	Hard bus tube, round Hard bus pipe, IPS and extra strong Hard bus tube, rectangular or square	Over 1 in. OD Over 4 in. OD Up to 6 in., over $\frac{3}{16}$ in. wall	97.40	**0.15737**	898.58	10.648	0.17702	1.7702	0.69692
.....	.....	.....	97.30	0.15753	899.49	10.659	.017720	1.7720	0.69763
B1-47	Hard, round	0.460–0.325							
B47-46 and B116-46	Hard trolley wire	All	97.16	0.15775	**900.77**	10.674	.017745	1.7745	0.69862
B33-46	Tinned soft, round	0.289–0.103							
.....	.....	.....	97.00	0.15802	902.27	10.692	.017775	1.7775	0.69979
B2-47	Medium hard, round	0.324-0.0403	96.66	0.15857	**905.44**	10.730	.017837	1.7837	0.70225
B188-47T	Hard bus pipe, IPS and extra strong	Up to 4 in. OD	96.61	**0.15865**	905.89	10.735	.017846	1.7846	0.70259
.....	.....	.....	96.50	0.15884	906.94	10.747	.017867	1.7867	0.70341
B1-47	Hard round	0.324–0.0403							
B33-46	Tinned soft, round	0.102–0.0201	96.16	0.15940	**910.15**	10.785	.017930	1.7930	0.70590
.....	.....	.....	96.00	0.15966	911.67	10.803	.017960	1.7960	0.70708
B33-46	Tinned soft, round	0.0200–0.0111	94.16	0.16279	**929.52**	11.015	.018311	1.8311	0.72092
B33-46	Tinned soft, round	0.0110–0.0030	93.15	0.16454	**939.51**	11.133	.018508	1.8508	0.72867
.....	.....	.....	90.00	0.17031	972.45	11.524	.019157	1.9157	0.75421
B105-47	Hard round, alloy, gr. 85	All	85.00‖	0.18039	**1,030**	12.206	.020291	2.0291	0.79885
B105-47 B9-46	Hard round, alloy, gr. 80 Alloy trolley wire, Class C	All	80.00‖	0.19159	**1,094**	12.964	.021552	2.1552	0.84849
B105-47 B9-46	Hard round, alloy, gr. 65 Alloy trolley wire, Class B	All	65.00‖	0.23573	**1,346**	15.950	.026516	2.6516	1.0439]
B105-47	Hard round, alloy, gr. 55	All	55.00‖	0.27864	**1,591**	18.854	.031343	3.1343	1.2340
B105-47 B9-46	Hard round, alloy, gr. 40 Alloy trolley wire, Class A	All	40.00‖	0.38319	**2,188**	25.928	.043103	4.3103	1.6970
B105-47	Hard round, alloy, gr. 30	All	30.00‖	0.51086	**2,917**	34.567	.057465	5.7465	2.2624
B105-47	Hard round, alloy, gr. 20	All	20.00‖	0.76638	**4,376**	51.856	.086207	8.6207	3.3940
Resistivity temperature constant	.....	.....	.....	0.000597	3.41	0.0409	.0000681	0.00681	0.00268

† ASTM unless otherwise noted.
‡ Matthiessen's standard.
§ International Annealed Copper Standard (IACS).
‖ Nominal value.

MOLONEY
LOAD CENTER TYPE UNIT SUBSTATIONS

SAFETY

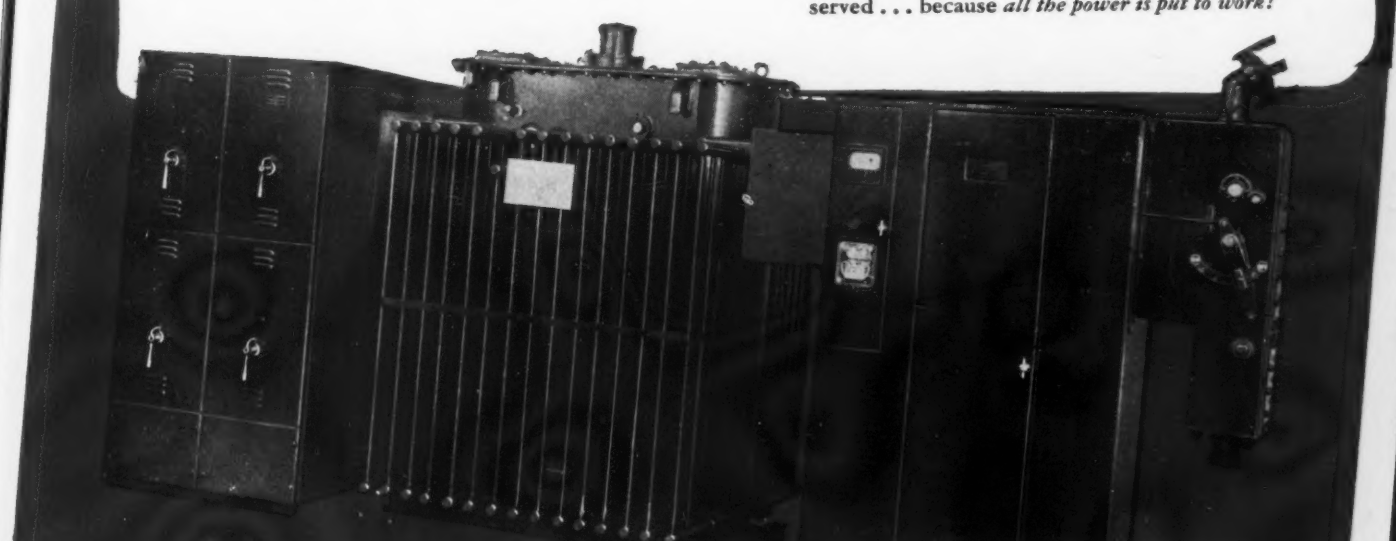
Live parts completely enclosed. No fire hazard. Transformers and primary switches Askarel or air insulated permitting indoor location without need for fireproof vault. Where primary switches are exciting current break type, interlocks prevent operation without first tripping secondary breakers.

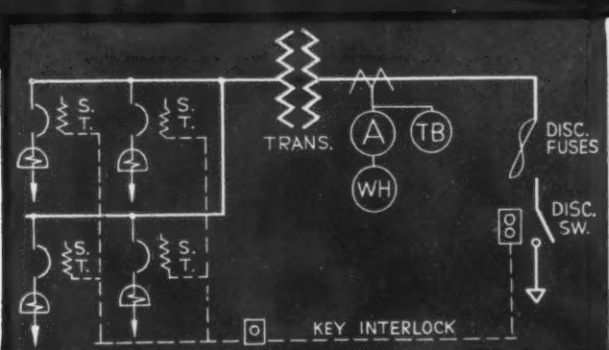
CONVENIENCE

Unit construction incorporating primary switch, transformer, and secondary air circuit breakers simplifies installation and operation. Indoor location and easy access to parts permits convenient inspection and maintenance. Unit substations can be supplied with primary air circuit breakers, selector switches, load break switches, power fuses, metering equipment or any other necessary features.

ECONOMY

Locating substation at center of load, indoors, eliminates long runs of expensive secondary copper. Better regulation increases voltage at points of use and heightens the efficiency of equipment served . . . because *all the power is put to work!*





Moloney Load Center Type Substation consisting of three sections: Primary Incoming Line Section . . . 5Kv Askarel-filled disconnect switch, primary power fuses, voltmeter and watthour with current and potential transformers. Transformer Section . . . 300 Kva, 3-phase 60 cycle, Moloney Askarel cooled transformer, 4160Y to 480 volts. Secondary Switch Gear Section . . . Four feeder Air Circuit Breakers of 25,000 amperes interrupting capacity.

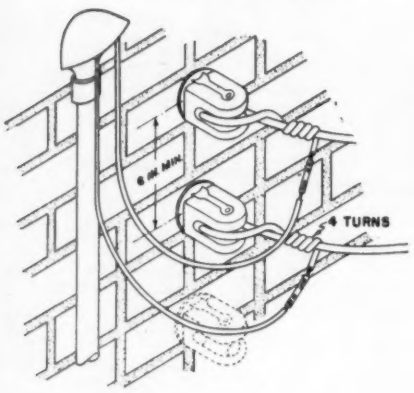
MOLONEY ELECTRIC CO. ☆ ST. LOUIS 20, MO.

BRANCH OFFICES IN ALL PRINCIPAL CITIES

Service Drop Attachment to Buildings

Installation of single-point wireholders and house brackets for service connections using wire sizes No. 8, 6 and 4. Three-wire service attachments similar to 2-wire installations shown, with appropriate materials and clearances. An adaptation from construction standards of Consolidated Gas Electric Light and Power Co. of Baltimore, Md.

SINGLE POINT WIREHOLDERS



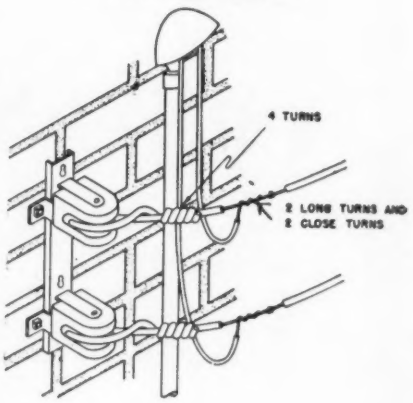
NOTES

When deadending wire leave 6 in. of excess to allow for connection to condulet. Select proper type and size of connector for wire size. When proper size connectors are not available, make solder taps. Both connectors and solder taps are to be wrapped with four layers of friction tape and paint with compound after applying each layer.

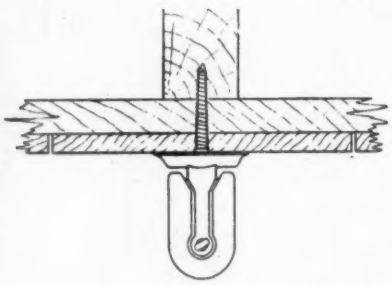
All brackets should be held by not less than four screws or bolts.

Conductors should be shaped to form drip loop.

HOUSE BRACKETS



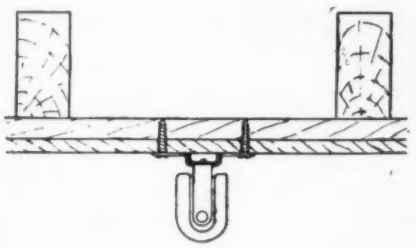
WOOD SIDING WITH WOOD OR ASBESTOS SHINGLES



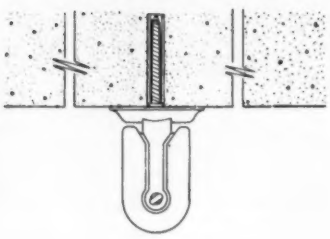
To prevent splitting, all shingles should be drilled before installing insulators.

(Left) Drill a 3/8-in. diameter hole through shingle only. Drill a 1/4-in. hole into the siding or stud behind the shingle.

(Right) Drill a 1/4-in. diameter hole through shingle only. Drill a 1/8-in. hole into the siding or stud behind the shingle. Use No. 16 galvanized wood screws 1½ in. to 2 in. long.

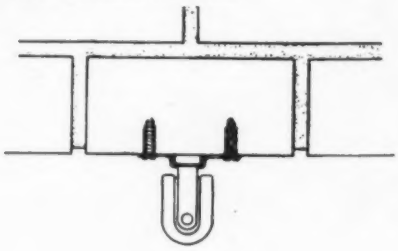


BRICK, STONE, CONCRETE BLOCK, CINDER BLOCK, CONCRETE AND HOLLOW TILE MASONRY ATTACHMENTS

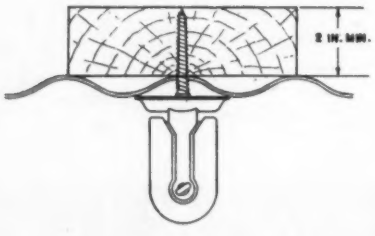


(Left) Drill 3/8-in. hole in face of brick 2⅛ in. deep using Rawl twist drill No. 20. Insert No. 22 x 2 in. Rawlplug.

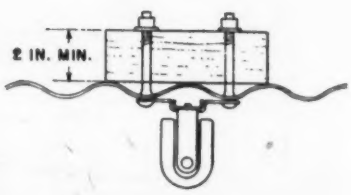
(Right) Drill 5/16-in. hole in face of brick 1½ in. deep using Rawl twist drill No. 16. Insert No. 16 x 1 in. Rawlplug. Fasten bracket with No. 16 galvanized wood screws 1½ in. long.



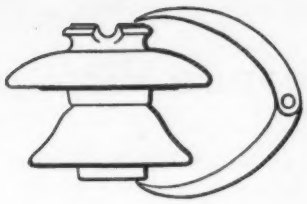
CORRUGATED IRON SIDING



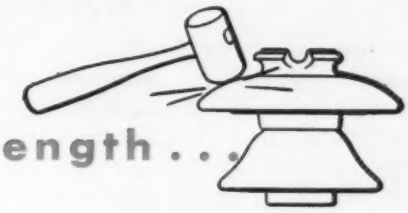
Attach insulators to wood frame having thickness 2 in. minimum. (Right) Fasten bracket with 3/8-in. carriage bolts of suitable length.



Any trade names and manufacturers catalog numbers used in identifying items or materials are for descriptive purposes only, and equivalent articles produced by other firms are acceptable



You can measure a Pintype's Size . . .

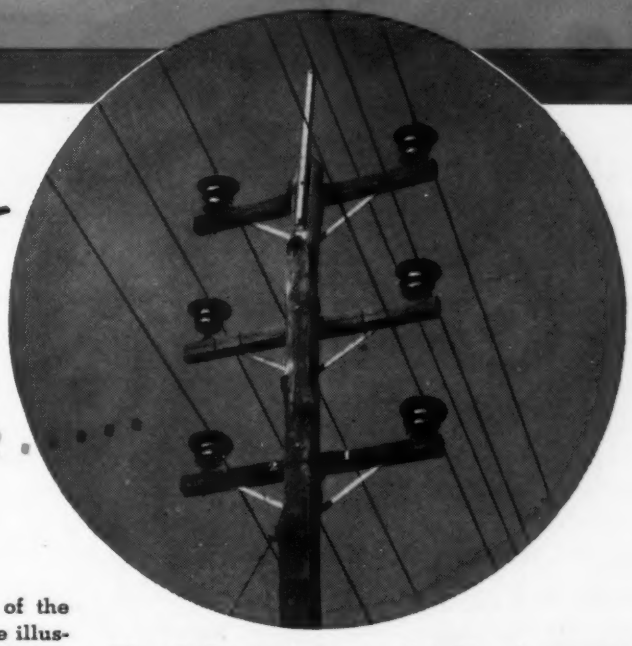


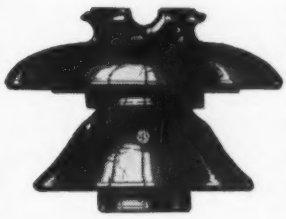
You can gauge a Pintype's Strength . . .

You can test its Dielectric Properties . . .

But YOU CAN'T TELL BY LABORATORY METHODS WHAT IT WILL BE DOING *30* OR *40* YEARS FROM NOW!

For the thing you want the most- long service life- you can depend upon this kind of evidence . . . .





Today's equivalent of the insulators on the line illustrated is the Number 31 855 pintype unit, rated nominally at 46 kv. Put this insulator on your lines--*and in your standards*--for long, trouble-free performance.

The O-B pintypes on this line have given complete satisfaction for 32 years--since 1916. This tradition of durability, plus many later improvements, is built into modern O-B pintypes.

Ohio Brass

Canadian Ohio Brass Company, Ltd., Niagara Falls, Ont.

MANSFIELD, OHIO

2962-11

Salvaged Pressure Gage Modified to Measure Vibration

To SURVEY high amplitude, low-frequency vibration in the uptake gas ducts at Jacksonville, Florida's Talleyrand municipal power plant, a vibration indicator was improvised from a salvaged 4½-in. Bourdon-type pressure gage. How this was done is shown in accompanying illustrations.

The pointer, dial, and socket screws shown in Fig 1 were removed from the gage. This permitted complete removal of the gage mechanism from its phenol case. Connecting link screws were removed, and the complete gage movement dismantled from its base in the socket.

A saw cut was made horizontally about half way through the socket and the Bourdon tube was cut off at its base. This provided room to cut the socket vertically to meet the horizontal cut as shown in the shaded area in Fig 2. The L-shaped bearing plate was removed to allow the reversal of the movement slide to the position shown in Fig 2. Then the top bearing plate was replaced.

The tip of the Bourdon tube was cut near the connecting link, and brazed at right angle to the end of a $\frac{3}{16}$-in. bronze welding rod 8-in. long. A hole was drilled vertically through the socket and reamed to fit this push rod as shown in Fig. 2. The light coil compression spring on the push rod is retained in position by a washer and pin.

The movement was replaced on its base, the connecting link installed between the sliding link and right-angled end of push rod, and entire assembly placed in the gage case.

By proper adjustment of the sliding link, the gage pointer can be made to cover the entire range of the original dial for 0.3 in. of push rod movement. A new set of dial markings completed the modification of the gage.

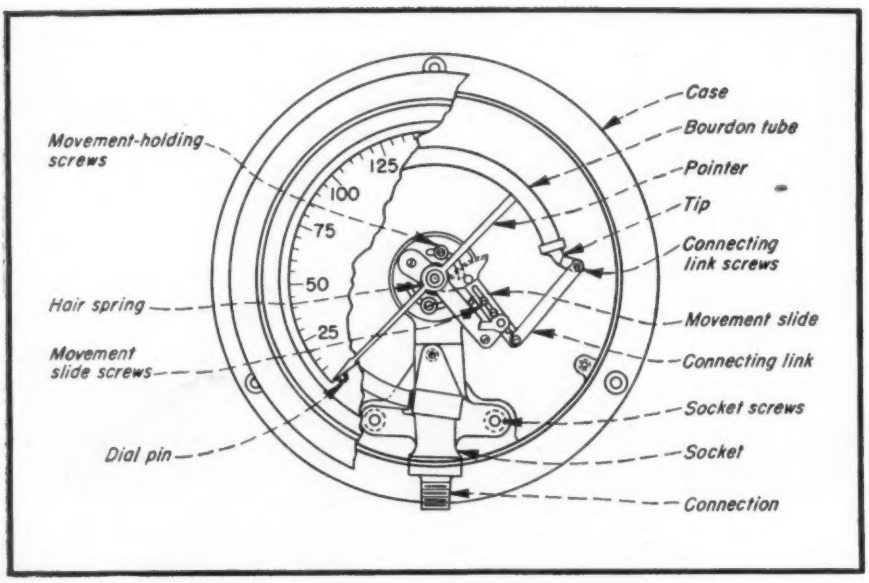


FIG 1—OLD PRESSURE GAGE showing nomenclature and arrangement of internal mechanism

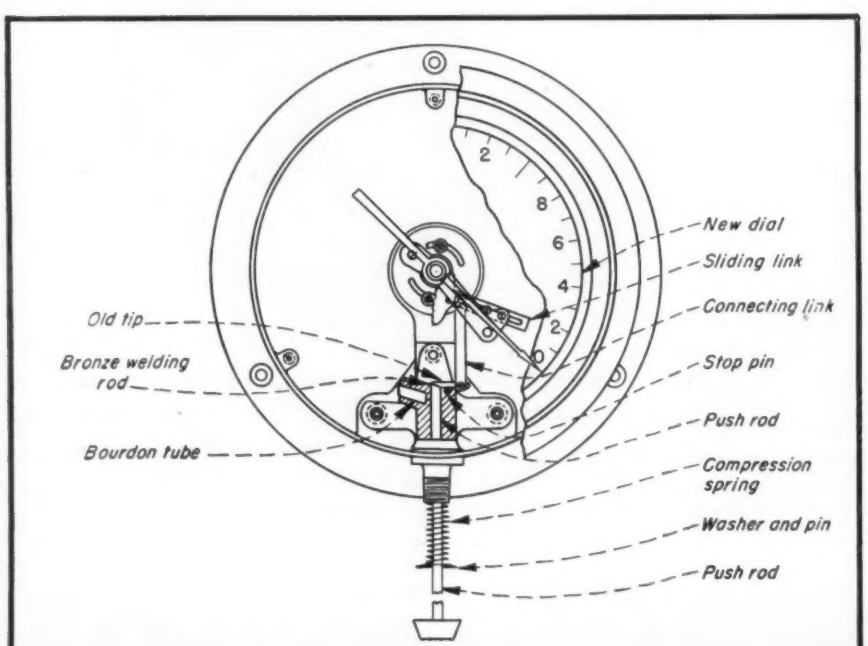


FIG 2—NEW VIBRATION INSTRUMENT showing modification and arrangement of pressure gage parts

Emergency Breaker Interlock Constructed on the Job

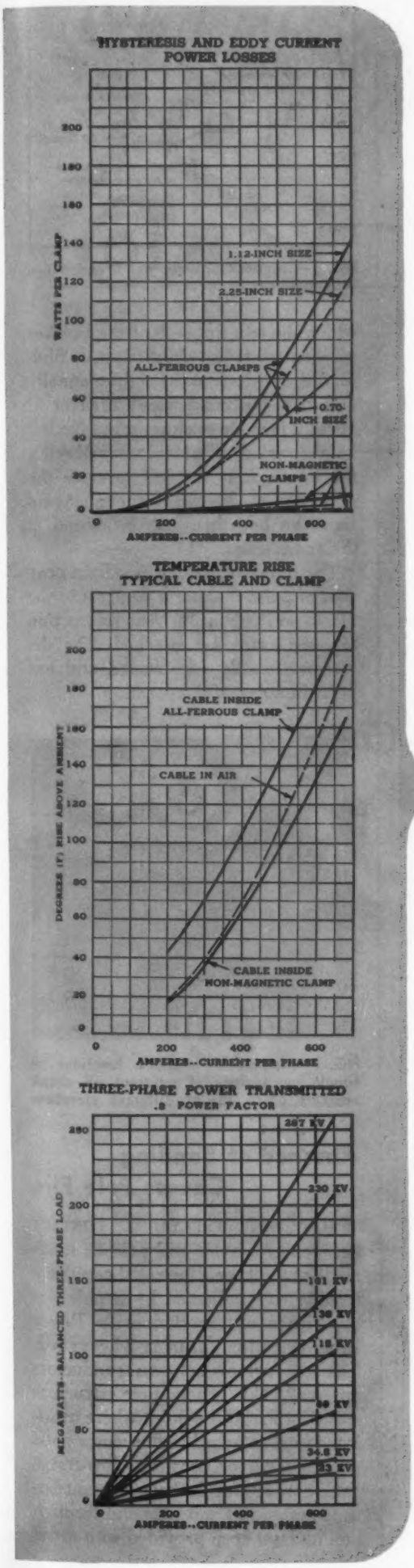
JOHN I. HURSH
Auburn, Indiana

INTERLOCKING of oil circuit breakers may at times become a major problem, especially when breakers of different designs are involved and are located at diffierent elevations. Further complications are encountered when electrical interlocks cannot be used. Such a condition existed when the author* was confronted with the problem of separating feeders that could not be paralleled to an important city water supply bus. Solution to that problem follows.

Breakers involved were types FK-5 and FK-32. The manual operating mechanism is tripped by lifting of finger "F" (Fig 1). The interlock consists of flat strap steel bent with an offset to accommodate the different elevations of the breakers as shown in Fig. 2.

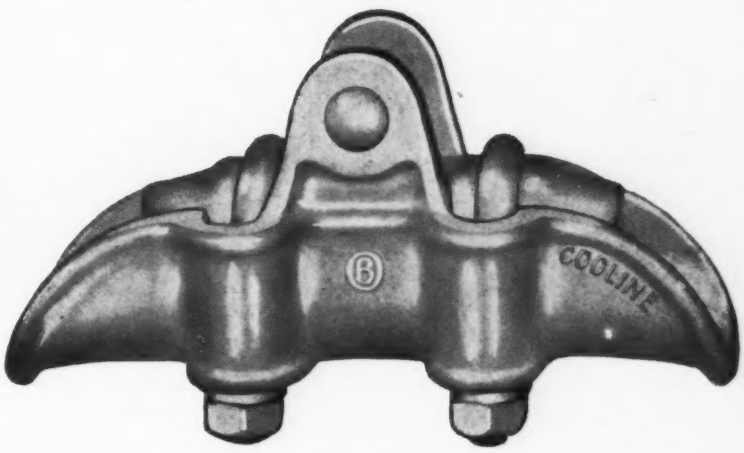
Fig. 1 shows construction of interlock with an adjustable part *T* over

* Author was Construction Engineer for City of Auburn, Ind., when installation was made at City of Auburn substation.



HOW TO MAKE GOLD OUT OF ALUMINUM

O-B COOLINE CLAMPS MADE OF NON-MAGNETIC ALUMINUM ALLOY OFFER ATTRACTIVE SAVINGS



Clamps that run cool save money. Due to the possibility of conductor annealing, heated clamps become a limiting factor on transmission amperages. O-B Cooline clamps relieve this. Amperages can be increased. More power can be delivered for sale at the meter. . . Heat comes only from dissipated kwh. It represents wasted fuel and *wasted generating capacity*. O-B Cooline clamps save practically all of this! . . These clamps may have a substantial operating advantage to offer you. It can best be figured on your own terms, and the curve data here will assist this. We will be glad to supply you with any further information, part of which includes quick delivery.

Ohio Brass

MANSFIELD, OHIO, U. S. A.

CANADIAN OHIO BRASS COMPANY, LIMITED, NIAGARA FALLS, ONTARIO

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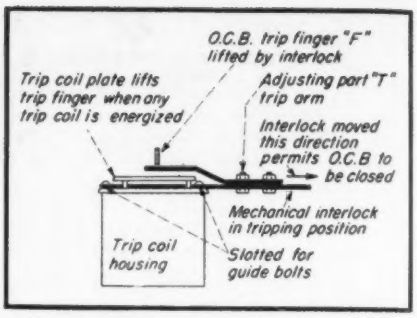

O.C.B. trip finger "F" lifted by interlock
Trip coil plate lifts trip finger when any trip coil is energized
Adjusting part "T" trip arm
Interlock moved this direction permits O.C.B to be closed
Mechanical interlock in tripping position
Trip coil housing
Slotted for guide bolts

FIG. 1—Interlock arrangement over trip coil housing of circuit breaker

which the trip finger *F* of the breaker mechanism rides when tripped. Sliding the interlock to the right manually will trip the right hand breaker if attempt is made to close it, but the left hand breaker can be closed. Moving the interlock to the left reverses the operation as described above. At no time can both breakers be closed at the same time.

The interlock was given a light gray coat of paint making a contrast to the black switchboard. An instruction tag can easily be attached. The device was easily constructed and has been in successful operation.

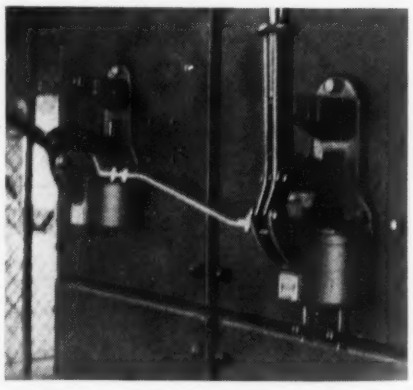


FIG. 2—Mechanical interlock functions on handle mechanisms of adjacent oil circuit breakers which are at different elevations

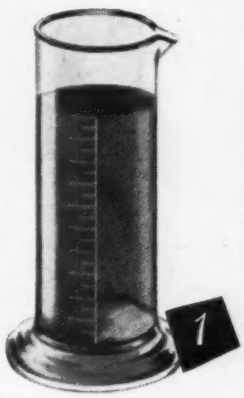
Absence of Bonding Causes Pole Fire

THAT POOR ELECTRICAL CONTACT between crossarms and pole on structures of the type illustrated can cause trouble was indicated by a pole fire experience of the Bonneville Power Administration. During a heavy fog, leakage current between conductors on a 230-kv wood pole structure started a fire at the point where crossarms were attached to the center pole.

This occurred because a low-resistance contact for leakage current between crossarm and pole and through bolt had not been provided with metal

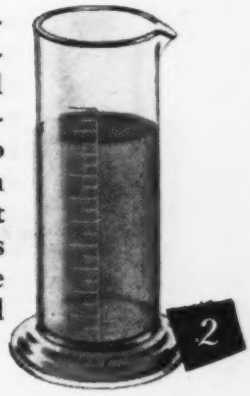
GULFCREST is the only turbine oil refined by the Alchlor Process*

. . . an extra step that removes this 15%

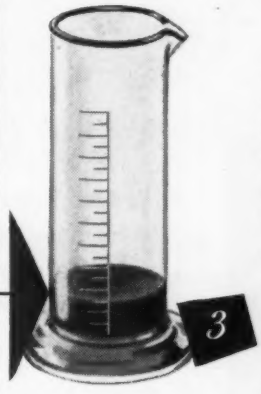


Gulfcrest is the only turbine oil that's Alchlor-processed.* This is an extra refining step. It makes Gulfcrest extra pure and extra efficient.

In Cylinder 1 you see the oil that will become Gulfcrest. It has already gone through the usual steps used in refining other turbine oils — but has not yet been Alchlor-processed.*



In Cylinder 2 you see the finished Gulfcrest—the incomparably pure lubricating oil that gives outstanding performance and helps keep steam turbine systems clean indefinitely. To make it even finer, special inhibitors are added to it — they give it even greater stability and protect against corrosion.



In Cylinder 3 you see the part—approximately 15%—discarded by the Alchlor Process.* This is the part that, when allowed to remain in turbine oil, is most likely to oxidize, increase neutralization number, and form sludge, emulsifiers, and harmful acids.

Call in a Gulf Lubrication Engineer today and ask him to recommend the proper grade of Gulfcrest Oil to meet the specific requirements of your turbines. Write, wire, or phone your nearest Gulf office.

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Address.....

Fresh farm butter . . . without elbow grease

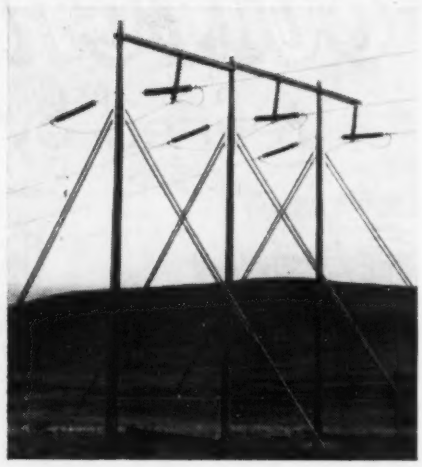
The sloosh-plop-splash-plop of the old hand-turned churn out in the farm house kitchen is almost a forgotten sound these days.

Elbow grease is no longer essential in butter making . . . or many other exacting chores down on the farm. And rural electrification gets the credit!

Much of the power for rural America is carried on lines equipped with Hemingray Power Insulators. These glass insulators, manufactured by a pioneer company, have kept pace with the program of electrification.

Every lot of Hemingray Power Insulators is tested under methods set by American Institute of Electrical Engineers in specifications No. 41-1944 (ASA C29-1944) and by the American Society for Testing Materials, D-730-43T.

HEMINGRAY
POWER INSULATORS
American Structural Products Company
MUNCIE, INDIANA
SUBSIDIARY OF OWENS-ILLINOIS GLASS COMPANY



OMISSION OF METAL WASHER between pole surface and inner side of crossarm to carry phase-to-phase leakage current on this 230-kv structure caused damaging pole fire

gain plate or metal washer between surface of crossarm and pole. Absence of a metal washer that was provided in design was due to oversight of the line contractor.

This fire which did extensive damage and caused line outage points up importance of assuring good electrical conductivity between crossarm and pole where surface leakage currents must pass from one to the other.

New Variable-Resistance Element

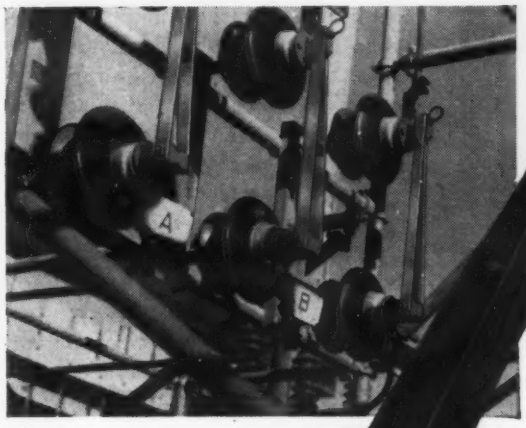
W. A. WILDHACK
National Bureau of Standards
Washington, D. C.

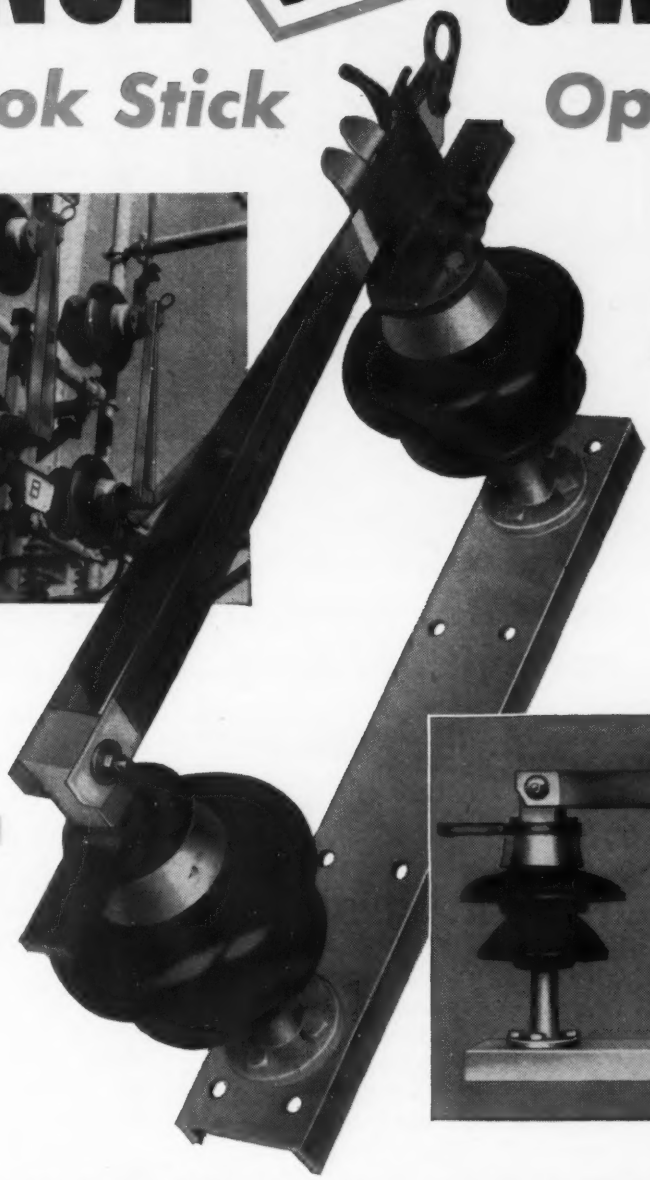
A HIGHLY SENSITIVE mechano-electrical transducer, which transforms slight displacements into large changes of resistance, current, or voltage, is being developed by the National Bureau of Standards. The active element of the device is a helical or conical spring wound in such a way that the initial tension varies slightly along its length. Thus, when the ends of the spring are pulled apart, the turns separate one by one rather than simultaneously.

When the spring is entirely closed, it has an electrical resistance approximately that of a cylindrical tube.

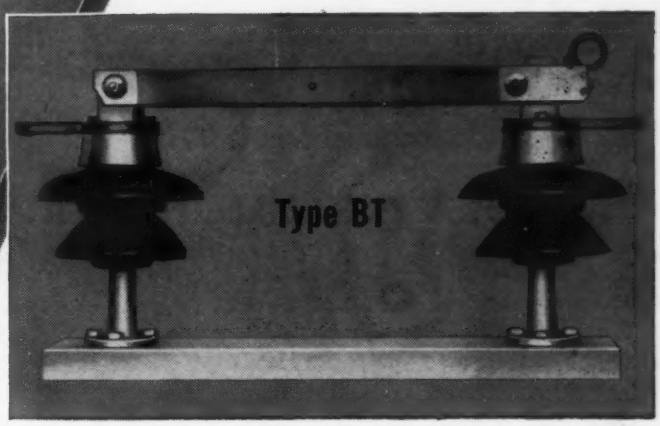
CHANCE Type BN-BT Switches*

Hook Stick Operated





Type BN



Type BT

For all types of Single Pole Installations

400 to 2000 Amp.
7.5 to 161 Kv.

Chance Hook Stick Operated Disconnecting Switches are made in a complete range of capacities in all voltages up to and including 161 Kv. They are available in single or double throw types for horizontal mountings—upright or underhung, and for vertical mounting up to 115 Kv.

● Sturdy Construction . . . High Conductivity

Chance BN and BT switches are ruggedly built throughout. Trussed blades add rigidity. All current carrying parts are constructed of high conductivity copper.

● Positive Blade Latches

Spring latches secure the blades in the contact clips and prevent opening under short circuits.

● Self-Aligning Clips

Contact clips on the BN switch are of the spring type which make positive contact even though blade may be slightly out of line. Tapered tongue on BT type guides blade to proper position—contact pressure is adjustable.

● Long Life Contacts

Silver surfaced area contacts are provided for long life.

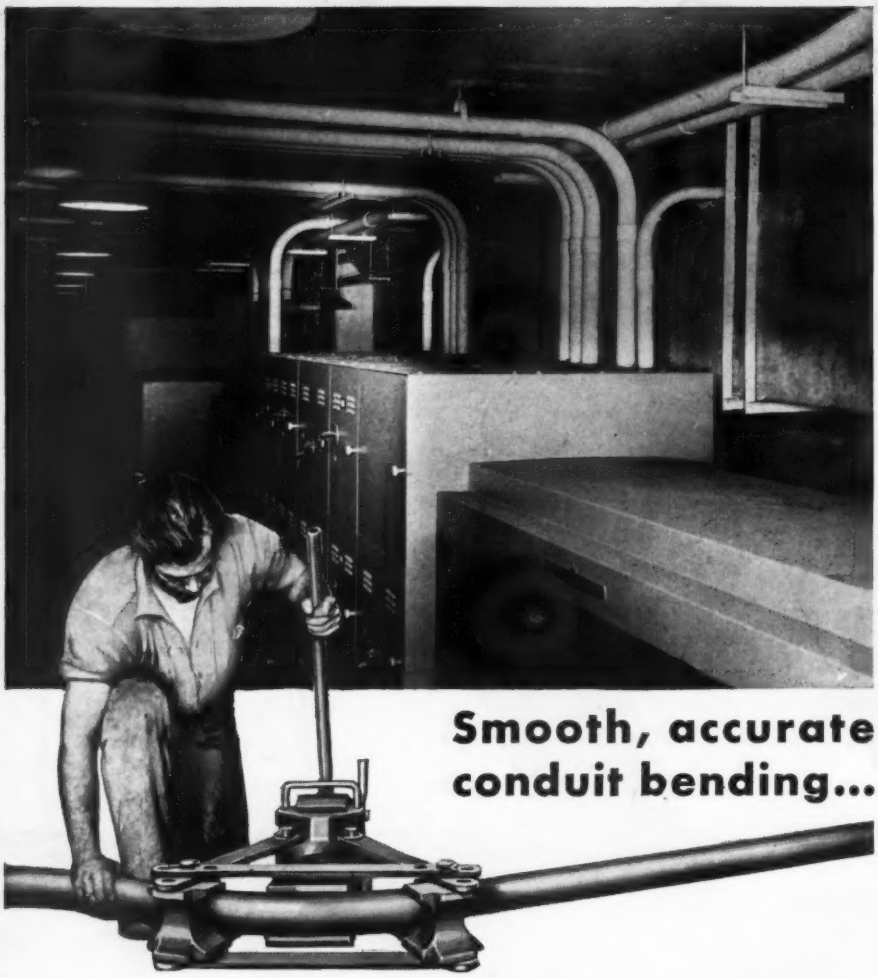
* CHANCE SWITCHES (FORMERLY BOWIE) ARE BACKED BY 42 YEARS OF SWITCH ENGINEERING AND MANUFACTURING EXPERIENCE.

A·B·CHANCE CO·

210 N. ALLEN STREET
CENTRALIA, MISSOURI · SAN FRANCISCO 7, CALIFORNIA
616 TENNESSEE STREET

abc INDUSTRIES

C4990



Smooth, accurate conduit bending...

...WITH A GREENLEE HYDRAULIC BENDER

Look at those smooth, accurate conduit bends shown in the photo above! They were made with GREENLEE Hydraulic Benders used on a recent installation by Emerson Garden Electric Company, Elizabeth, New Jersey.

J. G. Harrison, Superintendent of the company, in reporting on their experience with GREENLEE Benders says this: "We couldn't work without them. The GREENLEE can be relied on, day in and day out, for a first class job.

"Some of our GREENLEE Benders have been in continuous use for over 10 years and the savings they have provided over manual bending is tremendous."

Investigate the GREENLEE today. See how you, too, can make big time-savings . . . do the job faster, better.

The GREENLEE Hydraulic Bender is one-man-operated. Makes precise, neat bends in just a few minutes—in pipe up to 4½", rigid and *thin-wall* conduit, tubing, bus-bars. It's compact, portable, easy to set up and operate.

Get all the facts on this timesaving equipment, write for your copy of new free Bender Booklet E-201. Greenlee Tool Co., Division of Greenlee Bros. & Co., 1810 Columbia Avenue, Rockford, Illinois.

TOOLS FOR CRAFTSMEN

GREENLEE

OTHER GREENLEE TIMESAVING TOOLS FOR ELECTRICAL WORK

Hand Benders • Joist Borers • Cable Pullers • Radio Chassis Punches • Pipe Pushers

When it is completely open, its resistance is that of the total length of the coiled wire. Thus resistance can be varied over a wide range by stretching the spring. As the percentage change in resistance may be hundreds of times greater than the percentage change in length, displacements as small as 1/100,000 of an inch can be easily measured without the use of electrical amplifying devices. The spring transducer thus provides a sensitive means for conversion of any mechanical displacement to a change in an electrical quantity that can be precisely determined.

When connected to another transducer that gives a mechanical displacement output, such as a bimetallic strip responding to temperature changes, the combination gives an easily measurable electrical output. Possible applications include automatic temperature controls, dc-ac inverters, voltage regulators, strain gages, pressure elements, accelerometers, and electric weighing devices.

Bridge Circuit Preferred

The preferable construction for the transducer is a four-arm bridge of which each arm is a variable-resistance spring. An increase in applied tension elongates one pair of springs and shortens the other pair. The resistive unbalance of the bridge, as indicated by a galvanometer, is a measure of the displacement. With this arrangement, since the voltage can be nearly reversed through the bridge, the output voltage can be theoretically twice the input voltage.

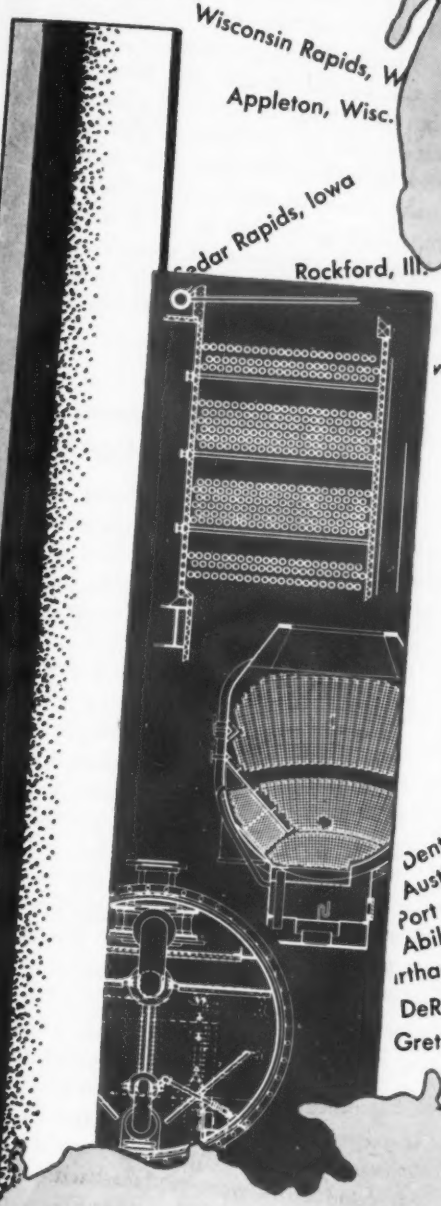
The variation of the initial tension of the spring along its length can be accomplished by: (1) Conical winding, (2) varying the angle of feed of the wire on a uniform mandrel, or (3) varying its tension as it is wound. For greatest sensitivity the variation in the initial tension is made quite small.

To decrease contact resistance between successive turns of the closed spring, a high average initial tension is built into the spring, and the turns are coated with 0.0001 inch of gold. Thus far, nickel-alloy wire has been mainly used, because of its high resistivity and small change of mechanical properties with temperature.

Development of the new transducer is part of a project on basic instrumentation for scientific research supported by the Office of Naval Research.

everywhere select Foster Wheeler

. . . feedwater heaters . . . evaporators . . .
. . . condensers . . . economizers



Redwing, Minn.
Minneapolis, Minn.
Wisconsin Rapids, W
Appleton, Wisc.
Cedar Rapids, Iowa
Rockford, Ill.
Grand Rapids, Mich.
roskey, Mich.
Dearborn, Mich.
sing, Mich.
Detroit, Mich.
Pontiac, Mich.
Whiting, Ind.
Groveport, Ohio
vana, Ill.
South Heights, Pa.
Campbells, Ind.
Louisville, Ky.
Port Rayon, Tenn.
Denton, Texas
Austin, Texas
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rthage, Texas
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Gretna, La.
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FOSTER WHEELER CORPORATION
165 BROADWAY, NEW YORK 6, N. Y.

FOSTER WHEELER

LOAD BUILDING

CUSTOMER LOCATES outlets for different uses by tacking up "tearouts" from wiring instruction book

"Tearouts" Help Planning of Farm Wiring

L. L. KOONTZ
Appalachian Electric Power Co,
Roanoke, Va.

EXACTLY WHERE he wants what specific outlets, that's what a farmer on the lines of the Appalachian Electric Power Co can show to his electrical contractor by means of a novel feature included in a booklet used by the company to promote adequate farm wiring.

Four pages of the booklet are comprised of perforated "tearouts," each tearout designating an outlet of a particular kind. The farmer tacks a convenience outlet tearout right where he wants that outlet to be. In like manner positions can also be indicated for outlets for switches, lights, appliances, and power equipment. The contractor thus sees what is wanted in the wiring installation and makes his estimate accordingly.

Advice and suggestions contained in the booklet enable the farmer to plan the wiring in terms of what electricity can do for him in the home and on the farmstead. The tearouts make a sort of game out of the planning, allow the job to be visualized completely, and permit consideration and revision to arrive at a satisfactory layout before final decisions.

Expend $228 Per Room For School Re-lighting

$71,177,76 was the total cost of relighting 245 rooms—228 classrooms and shops, and 19 offices and other rooms—in 6 Birmingham, Ala, public schools, according to a report prepared by Charles C. Cornic, business manager of the city's school system. This is an average of $288 per room. This figure is merely a convenient expression of unit cost. Included in it is the average room's share in improving the lighting in corridors, stairways, rest rooms, boiler rooms, storage rooms, etc. All classrooms and shops are equipped with fluorescent lighting; in most of the other spaces, incandescent is used.

The average classroom is 22 to 23 ft wide and 30 to 33 ft long. In most classrooms 12 fixtures are installed, 2 continuous rows of 6 each. Intensities range from 30 to 40 ft-c. Where conduit was in place and usable, old conductors were replaced with larger type T wires; all the other new wiring was done with Wiremold. Multibreaker panels were installed.

The complete relighting project includes nearly 1,500 rooms of all kinds. Started in June, 1946, the work is being done by the School Board's own staff of workmen, supplemented in vacation and holiday periods by school shop instructors.

How the improved lighting has in-

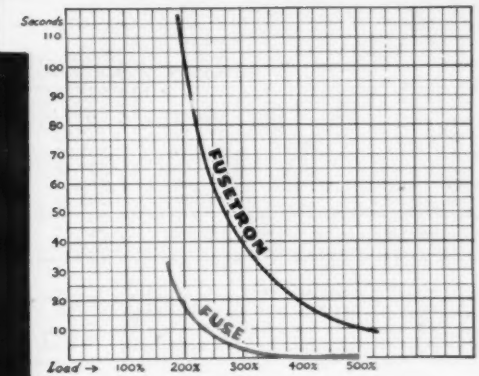
Keep Your Men and Machines on the Job!

With Fusetrons installed throughout your electrical system you will be entirely free of shutdowns caused by fuses blowing on motor-starting currents or other harmless overloads.

It is the time-lag of Fusetrons that does it. For instance: at 300% load a 30 amp. 250 volt Fusetron will hold 39 seconds before opening — yet the ordinary fuse with the longest time-lag will blow in 2/10 seconds. The Fusetron holds 15 times as long.

Other size Fusetrons in both 250 and 600 volt types show similar results . . . yet —

With all this time-lag there is no sacrifice of safety as is assured by the Underwriters' Laboratories inspected label carried by Fusetrons.



Ability of Fusetrons to hold starting currents or other harmless overloads is shown by above curve on 30 amp., 250 volt size. Other 250 volt sizes and 600 volt sizes show similar results.

Why worry with Electrical Shutdowns? — do something about them.

The tremendous time-lag of Fusetrons wipes out needless shutdowns so completely that you are able to:

Start all the motors on a circuit at one time — and the Fusetrons won't open.

Have machines momentarily jam or be overloaded — and the Fusetrons won't open.

Throw a bank of welders across the line — and the Fusetrons won't open.

Load your circuits nearer to the capacity of your switches and panelboards — and not be penalized by recurring useless shutdowns.

If you want the nearest thing to complete freedom from needless interruptions of electrical service, without in any way sacrificing safety — install Fusetrons throughout your entire electrical system.

Get All the Facts—Find out how it will pay you to install Buss Fusetrons throughout your electrical system.

One needless shut down — or one lost motor — or one destroyed panel, may cost you far more than replacing every fuse with a FUSETRON.

Don't risk such losses — protect yourself by changing over your entire electrical system to FUSETRONS.

Fusetrons GIVE MANY Kinds of Protection Heretofore NOT Available

★ Entirely wipe out needless blows caused by motor starting currents or other harmless overloads.

★ Give Thermal Protection to Panelboards and Switches.

★ Operate cooler because of lesser resistance, thus prevent needless blows caused by heating in panelboards and switches.

★ Permit use of larger motor or adding more motors on circuit WITHOUT installing larger switch or panel.

★ On new installations, PROPER size switches and panels can be used instead of OVERSIZE.

★ Protect small motors against burnout, simply and inexpensively.

★ Give DOUBLE protection to large motors.

★ Provide simplest way to stop burnouts from single phasing.

★ Protect coils, transformers and solenoids against burnout.

Send the Coupon Now!

Bussmann Mfg. Co., University at Jefferson
St. Louis 7, Mo. (Division McGraw Electric Co.)

Please send me complete facts about BUSS Fusetrons.

*Name*_____

*Title*_____

*Company*_____

*Address*_____

*City*_____ *State*_____ 1048

FUSETRONS

Sold Through Wholesalers

Summary of Re-Lighting Costs, Birmingham (Ala) Schools

School	Installation Costs $					Average Energy Use per Month—Kwhr		Average Bill per Month—$	
	Fixtures and Accessories	Wiring Materials	Labor	Total	Approx Average per Room	Before Relighting	After Relighting	Before Relighting	After Relighting
Cunningham	5,557.73	934.42	1,772.34	8,264.49	360	518(1)	3,700(2)	16.31(1)	116.55(2)
Phillips High	22,977.73	1,157.13	3,571.84	27,706.70	267	11,713(3)	15,608(4)	265.93(3)	323.59(4)
Lakeview	5,194.08	1,501.29	1,801.31	8,496.68	370	2,214(5)	3,872(6)	69.73(5)	98.39(6)
Martin	5,091.15	575.46	1,532.58	7,199.19	327	803(7)	2,709(8)	25.29(7)	85.33(8)
East Thomas	867.99	166.31	187.10	1,221.40	245	(9)	182(10)	(9)	5.15(10)
Parker High	14,447.00	1,033.06	2,809.24	18,289.30	258	5,541(11)	16,200(12)	131.36(11)	296.28(12)
Totals and Averages	54,135.68	5,367.67	11,674.41	71,177.76	288(13)	4,409(13)	7,063(14)	107.11(12)	163.53(14)

(1) 9 mo's, Sept-May, '45–'46; (2) 7 mo's, Apr-May, Sept-Dec, '47, Jan '48; (3) 9 mo's, Sept-May, '45–'46; (4) 6 mo's, July-Dec, '47; (5) 9 mo's, Sept-May, '45–'46 (6) 5 mo's, Sept-Jan, '47–'48; (7) 9 mo's, Sept-May, '45–'46; (8) 9 mo's, Feb-May, '47, Sept-Jan, '47–'48; (9) School not previously lighted; (10) 9 mo's, Feb-May, '47, Sept-Jan, '47–'48; (11) 19 mo's, Sept, '45, Mar, '47; (12) 3 mo's, Nov-Jan, '47–'48; (13) 5 schools, 55 mo's; (14) 5 schools, 39 mo's—East Thomas school not included in overall averages because it was not lighted previously; (15) Total, 247 rooms—228 classrooms and shops, 11 offices, 3 auditoriums, 2 libraries, 2 study rooms, 1 lunchroom.

creased utility revenue is indicated by the "before" and "after" averages of monthly bills for electricity shown in the accompanying tabulated summary of costs. The installation costs were copied from Mr. Cornic's report, and the monthly averages of energy use and of service bills were calculated from data in it.

PUSH LAMP SALES FOR EXTRA PROFITS!
HERE'S THE FIRST STEP IN YOUR WINDOW DISPLAY
Inform your residential, commercial and industrial customers that you have a good stock of lamps on hand and make them lamp conscious.
Be sure they get the right lamp for the purpose.
Remind them that burnt-out lamps are useless and should be replaced.
Suggest that they fill all empty sockets.
Convince them of the convenience of a reserve supply of lamps.
OH SAY! CAN YOU SEE?
GET THE LIGHT BULBS YOU NEED HERE...NOW
This colorful, eye-catching window streamer will be the starting point for that important window display . . . the springboard for your profitable 1948 Lamp Campaign.
VICTORY DINNER
All dealers whose efforts during this campaign earn a prize will be invited guests of the Associ-

DEALERS ARE STEAMED UP to push lamp sales in campaign contest

Prizes to Spur Lamp Sales

RETAILERS of lamp bulbs in and around Philadelphia will aim at money prizes totalling $1,020 in an October campaign sponsored by the Electrical Association of that city. For the contest, dealers are divided into 3 groups, those whose normal lamp sales average over $60 per month, those whose sales fall between $60 and $25, and those with sales of less than $25. In each group, the first 3 prizes are the same, $50, $40 and $25. In the distribution of the remaining prizes there is apparent an effort to spur sales by the smaller dealers. Total of 13 prizes in the first group is $270, and the distribution here tails off with 5 prizes of $15 and 3 of $10. In the second group, there are 26 prizes which amount to $440, of which $250 goes to the runners-up in 10 of $15 and 10 of $10. The third group will divide $310 in 26 prizes of which the last 10 are $5 each, and the next-to-last 10 are $10 each.

The contest is open to all dealers selling General Electric, Sylvania and Westinghouse lamps. Announcement of the contest was mailed to each dealer with a return postcard to serve as entry and to indicate group classification. Included with the announcement was a 45-inch window streamer, "Oh Say! Can You See?" as shown in the accompanying illustration. Judging of winners will be on window display, interior display, outside selling, advertising, novel promotional ideas, results achieved in increased sales. Following the campaign, the Association will give a celebration dinner for the winners at which the prizes will be awarded.

14-Hour Working Day For Laying Hens

UNTIL some speckled Plymouth Rock or pugnacious Rhode Island Red organizes a hen's union to demand shorter working hours, men will continue to kid the egg producer into greater effort. According to a recent release by the U. S. Department of Agriculture, experiments have shown that it is good business to make the hens put in a 14-hour working day. This means that with twilight coming at 4 or 5 o'clock of a winter afternoon the electric lights in the laying house should be turned on at 2 or 3 in the morning. Thus the biddies are up and scratching long before the most early-rising farmer begins to stir. On the average it takes about 15 kwhr per month per hundred birds to provide this much lighting for the laying flock.

RUN A FEVER . . .

FOR HIGH OPERATING TEMPERATURES in power, heat and lighting circuits, Roebling Varnished Cambric Cable gives you heat-resistant insulation far and away superior to rubber. There's no better specification for generator and motor leads . . . it's proved an outstanding performer on leads for transformer and oil switches.

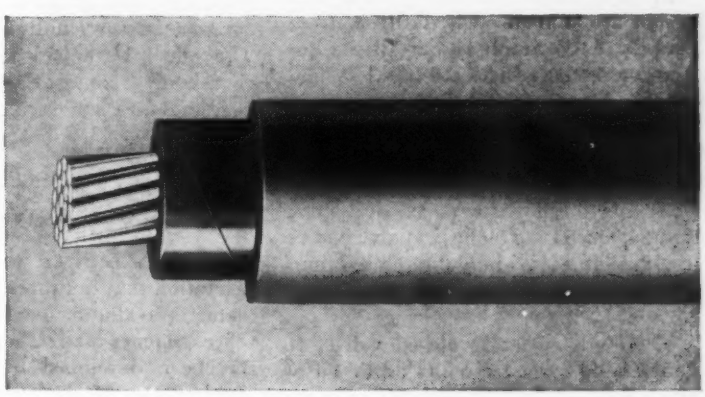
Roebling Varnished Cambric Cable is made in single and multiple conductor types . . . single, in sizes from 2,000,000 C.M. to No. 14 A. W. G. Both constructions are recommended for use up to 17,000 volts between phases . . . 26,000 volts for single conductor grounded neutral. The cable is given a lead sheath for service where moisture is encountered and for underground installation. Other types of outer coverings are often supplied to adapt the cable for special conditions.

Like all Roebling electrical wire and cable, Varnished Cambric Insulated Cable is a combination of the finest materials and of Roebling engineering, experience and production skill . . . your assurance of superior, lasting service. Write for Catalog J-900 and for any detailed information you may require, or communicate with your nearby Roebling distributor—he'll be glad to help you.

JOHN A. ROEBLING'S SONS COMPANY

TRENTON 2, NEW JERSEY

Branches and Warehouses in Principal Cities



★ WIRE ROPE AND STRAND ★ FITTINGS ★ SLINGS ★ SUSPENSION BRIDGES AND CABLES ★ AIRCORD, AIRCORD TERMINALS AND AIR CONTROLS ★ AERIAL WIRE ROPE SYSTEMS ★ ELECTRICAL WIRE AND CABLE ★ SKI LIFTS ★ HARD, ANNEALED OR TEMPERED HIGH AND LOW CARBON FINE AND SPECIALTY WIRE, FLAT WIRE, COLD ROLLED STRIP AND COLD ROLLED SPRING STEEL ★ SCREEN, HARDWARE AND INDUSTRIAL WIRE CLOTH ★ LAWN MOWERS

ROEBLING

A CENTURY OF CONFIDENCE

NEW EQUIPMENT

Squirrel Cage Motors

A NEW LINE of tube-type, totally enclosed, fan-cooled, squirrel-cage motors ranging from 150 to 600 hp has been introduced by Allis-Chalmers Mfg Co, Milwaukee, Wis. Use of tubular type heat transfers follows, in general, the methods employed in previous motors of larger size built by the company.

Internally, the new motor is divided into two isolated parts with each side having its own path of internal air circulation. The manufacturer states that because of the construction, it is possible, through simple maintenance, to keep the motor free of power-destroying agents which tend to clog air passages in the conventional type of fan-cooled motors.

The new line is being offered with Underwriters' labels for 1-D or 2-G locations in ratings of 3600-rpm, 250 to 400-hp; 1800-rpm, 200 to 300-hp; and 1200-rpm, 150 to 200-hp.

•

Solenoid Valve

SHUT-OFF solenoid valves in a new design are announced by Caltron Products Co, 1406 South Hobart Blvd, Los Angeles 6, Calif. The electrical section of the valve is stated to be isolated from the flow section.

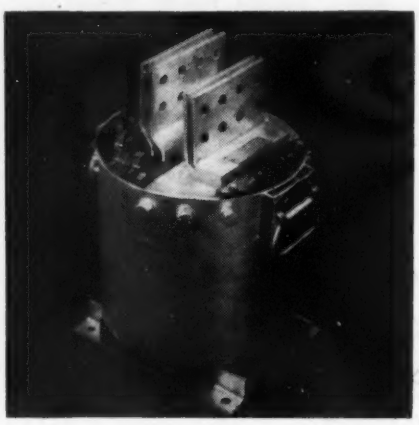
Due to the direct flow design, the valve is claimed to have a very small pressure drop. Operating pressures range from zero to 600 psi. Valve bodies are available in aluminum, brass and stainless steel. Port openings are ⅛, ¼ and ⅜ in.

This is a normally closed valve. It is available for a-c circuits 32 to 440 v and d-c circuits 6 to 115-v.

•

Current Transformer

A PORTABLE current transformer in the high-current range, stated to be more precise than any previously built, is announced by Westinghouse Electric Corp, P. O. Box 868, Pittsburgh 30, Pa. Based on a new principle in design, error-causing effects of stray magnetic fields from the same or other circuits are completely eliminated. The transformer has an accuracy of plus or minus one-tenth of one percent and five minutes phase angle over the range of current from 10 to 150% at burdens up to 0.5 ohms (ASA standard B-0.5). The 130-lb transformer has eight current ratings from 1000 through 4000 amp primary to 5 amp secondary. Terminal are provided for connection of either cables or bus bars.



High accuracy of the new current transformer is accomplished by passing primary current through the windings in the usual manner and then fanning out the primary conductor into a copper shell and bending it back in a "U" turn completely surrounding the windings. The effect is to isolate the secondary completely from any field but that of the current being measured.

•

Latex-Coated Wire

A NEW electrical wire with rubber insulation that improves when soaked in water is available for wiring factories, offices, homes and other buildings. It has been developed by United States Rubber Co, Rockefeller Center, New York, N. Y. The wire's durability is reported to be a coating of natural rubber latex applied by the dip process.

The new wire is designed for use underground and in wet locations where high moisture resistance is said to give it longer life and increased safety. It is particularly suitable for underground lead-ins and wiring damp basements. It is also recommended for police and fire alarm cables.

Trade name is Laytex RUW. Sizes available are solid or stranded copper No. 14 to 6 AWG single conductor, pair or cable.

Tests conducted by Underwriters' Laboratories, Inc, where the wire was immersed in water at a temperature of 122 F for 24 weeks, showed an insulation resistance curve that rose from 500 megohms to 2,400 megohms per 1,000 ft of wire. A normal insulation resistance curve shows a sharp drop after 2 to 4 weeks immersion.

•

Service Drop Cable

A NEW 600-v service cable of the self-supporting type and known as RoPrene service drop cable is now being manufactured by the Rome Cable Corp, Rome, N. Y. For 3-wire service, this cable is made up of two power conductors of stranded soft drawn copper insulated with a heavy wall of RoPrene (Neoprene), twisted around a bare neutral of hard drawn copper, which serves as a supporting messenger.

Tests on this cable indicate that it withstands a continuous a-c potential of 4800 v between insulated conductor and ground electrode for a minimum of 4000 hr without failure, after subjection to 100 hr of the Weather-O-Meter cycles.

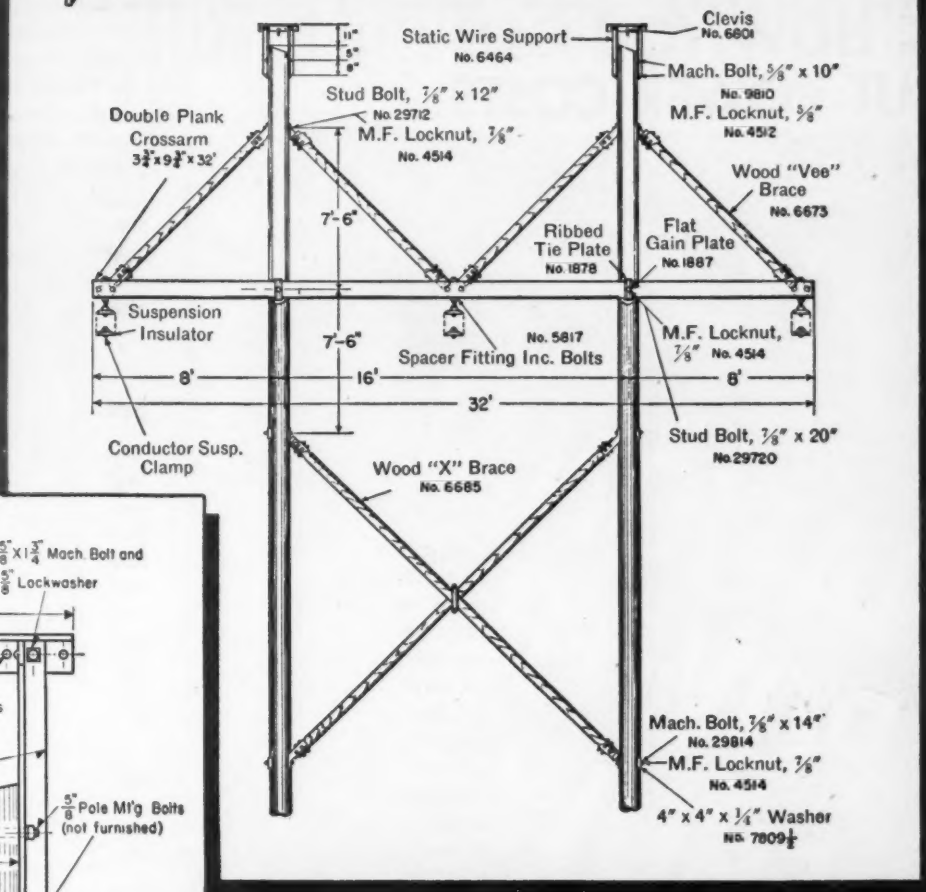
At present, the cable is available in sizes 8, 6, 4 and 2 AWG. In localities where a bare neutral is not permitted substitution of solid hard drawn double braid weatherproof wire is recommended.

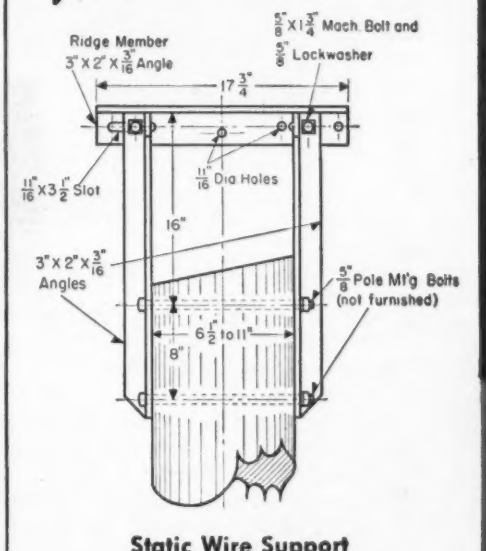
•

Air Filter

AN ELECTRONIC AIR FILTER, the Electro-PL, has been developed by American Air Filter Co, Inc, 215 Central Ave, Louisville, Ky. The equipment is reported to have an intermediate cleaning efficiency for applications where the efficiency of a mechanical filter is too low and that of an electronic precipitator is unnecessarily high. The new filter is basically an electronic precipitator without an ionizing unit and contains a collector element of electrostatically charged Airmat paper.

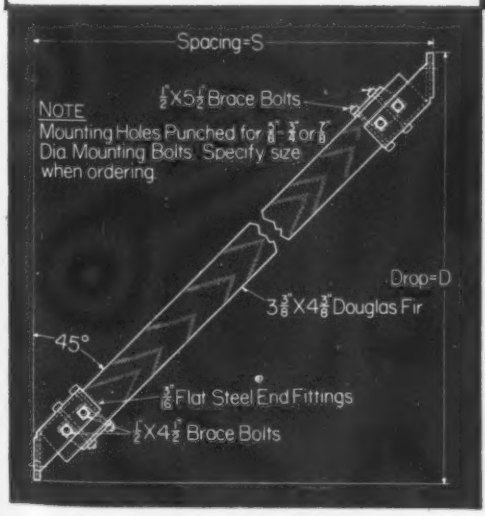
The paper is a laminated cellulose product composed of a number of plies of porous, tissue-like sheets formed of short fibers in "jackstraw" arrangement and is also used as a filtering media in mechanical filters.





Static Wire Support
No. 6464

Typical Tangent Structure by HUBBARD


Spacing=S
NOTE
Mounting Holes Punched for 5/8"-3/4" or 7/8" Dia. Mounting Bolts. Specify size when ordering.
5/8" X 5 1/2" Brace Bolts
Drop=D
3 3/8" X 4 3/8" Douglas Fir
45°
5/8" Flat Steel End Fittings
1/2" X 4 1/2" Brace Bolts

Hubbard "Vee" Brace
No. 6673

The H-Frame shown above consists basically of two poles of proper height and classification for 69 to 161 KV construction to which are attached two 3¾" x 9¾" x 32-foot Fir Cross Arms. Poles are slab-gained to a thickness of 7½-inches so that factory-assembled crossarms may be used. A No. 6464 Static Wire Support is mounted on each pole-top and No. 6673 Vee Braces are used to give added strength to the structure. The No. 5817 Steel Spacer Fittings serve a multiple purpose. They space the plank arms, provide a mounting point for the Vee Braces and are the points of suspension for the Insulator strings. No. 6685 Cross Brace is used to give transverse strength to the structure.

For detailed bill of materials, see your Hubbard representative or write to Hubbard and Company.

HUBBARD AND COMPANY

PITTSBURGH
CHICAGO

OAKLAND,
CALIF.

SEE HOW YOU CAN CUT POWER COSTS AT THE...

18th NATIONAL POWER SHOW

NATIONAL EXPOSITION OF POWER & MECHANICAL ENGINEERING

GRAND CENTRAL PALACE, N.Y.

NOV. 29 to DEC. 4

Over 300 outstanding technically-staffed exhibits and first-hand demonstrations of latest cost-saving equipment, materials and methods for steam, electric and mechanical power production and application—for economical materials handling — for efficient plant services — for expanding and modernizing power facilities. New cost-cutting ideas never were so important as now. So mark the date—plan to attend. See, learn and compare!

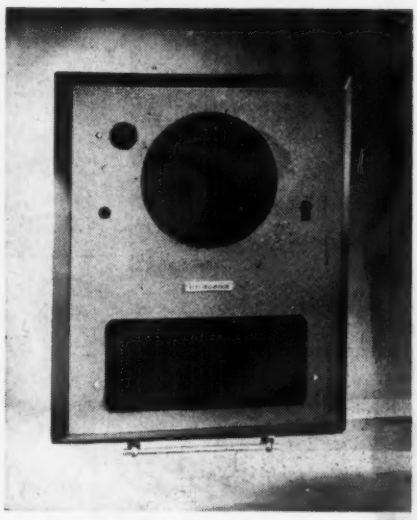
Management International Exposition Co.

4545

When an electrostatic charge is applied to the paper, the plies tend to separate and each individual fiber becomes a collecting electrode which attracts and holds dust and smoke particles.

Since the Electro-PL will continue to function as an efficient air filter when deenergized, its operation may be varied to suit the dust condition—as an electronic air cleaner during the winter months and as a dry-type air filter during the summer months.

•



Electric Unit Heaters

A NEW LINE of all-electric heaters includes portable and wall-type units for homes, stores and offices, as well as heavy-duty unit heaters of all sizes for plants, stores and farms. The units are produced by Electromode Corp, 45 Crouch St, Rochester 3, N. Y.

All models circulate heated air with a fan. Heat is generated by a patented cast-aluminum heating element which contains no exposed wires or glowing coils and which is said to give complete safety from fire, shock or burn. The space heaters have a silver-gray finish and are available for commercial voltages. Illustration is a Bilt-in-Wall Down-Flo heater with automatic built-in thermostat.

•

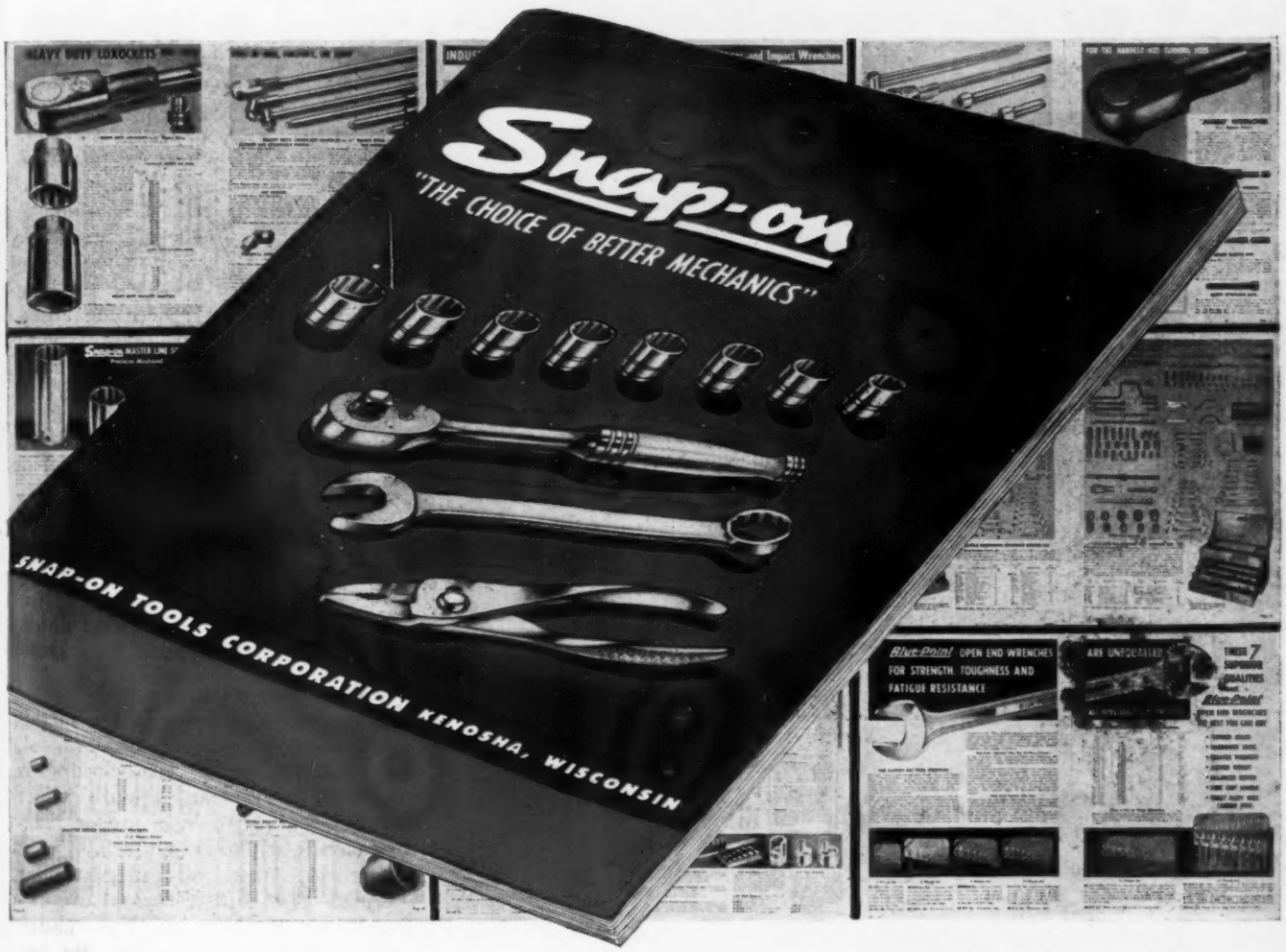
Control Relay

FOR USE on d-c, a-c and half-wave rectified a-c circuits, a miniature relay identified as type 118 XBX has been developed by Struthers-Dunn Inc, 150 North Thirteenth St, Philadelphia 7, Pa. The design has hinge-pin armature suspension. A unique magnetic structure utilizes two working air-gaps said to result in high sensitivity on direct current.

The relay has dpdt contacts rated 2 amp at 115 v, a-c. Normal d-c operating power is 0.15 w with a maximum coil

The New Snap-on Catalog

of Mechanics' Tools now ready for distribution



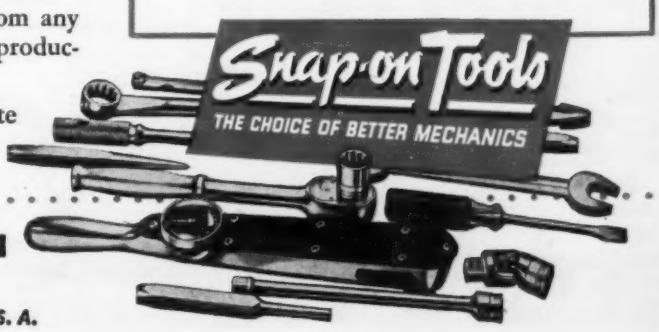
Send for your copy today!

It's new! It's factual! It shows the complete line of Snap-on mechanics' tools in sets and as individual pieces! It gives you sizes, construction and special features! It illustrates and describes many reasons why Snap-on tools are the choice of better mechanics everywhere!

There are 5 reasons why Industrial firms find it pays to use Snap-on tools throughout their plants. (1) Quality is the finest possible. (2) Widest range available from any one source. (3) Personalized service that only Snap-on can render. (4) Prompt shipment from any one of 40 factory warehouses. (5) Facilities for quantity run production of special tools.

Write for this and other special catalogs showing complete line of industrial sockets for power and impact wrenches.

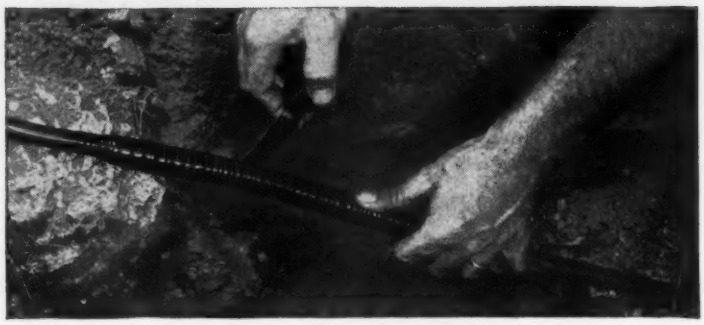
Branch Sales Offices Located in 40 Principal Cities Provide Snap-on Service to all important Industrial areas



SNAP-ON TOOLS CORPORATION

8108-J 28TH AVENUE • KENOSHA, WISCONSIN

International Division: Kenosha, Wisconsin, U. S. A.



A SERVICE LIFE OF 35 to 40 YEARS FOR UNDERGROUND CABLE AND SPLICES

A new lighting system installed in a western city has an underground cable that is a single solid conductor insulated with polyethylene and jacketed with polyvinyl chloride. Splices are wrapped and built up to 1½ times the cable insulation with No. 33 "SCOTCH" Electrical Tape with Vinyl Plastic backing. In a series of tests one such splice stood 70,000 volts for 45 seconds. Engineers on the job predicted a service life of 35 to 40 years for cable and splices.

If you have an insulation problem that is bothering you why not write today for a "SCOTCH" Tape field Engineer? His experience and advice may save the day for you.

No. 33 SCOTCH Electrical TAPE

ANOTHER 3M COMPANY PRODUCT

Made in U.S.A. by MINNESOTA MINING & MFG. CO. St. Paul 6, Minn.

resistance of 220 ohms. The a-c relays operate on approximately 9 va with coils up to 115 v, 60 cycles.

Open type relay is 1½ in. high, 1⅛ in. long, 1 in. wide and weighs approximately 2 oz. A metal enclosure is 1⅜ in. square and 1¾ in. high.

•

Lamp Capacitor

A CAPACITOR, type KX-103, for use in cold cathode fluorescent lamp equipment has been developed by Cornell-Dubilier Electric Corp, South Plainfield, N. J. Three capacitor elements are combined in a single compact case —rectangular, 2⅛x2⅛x2¾ in.—to conserve space in the ballast housing.

Other features of the new capacitor are: Molded plastic cup-shaped terminal insulators that provide extra long creepage to the case; permanent hermetic seal assured by the drawn type of container with its reinforced seam cover; and dykanol A impregnation and fill, kraft paper dielectric.

Specifications are: 0.006 — 0.006 mf 750 v ac, plus 0.51 mf 1050 v ac. The same type is available in other capacity combinations, single or multiple units, at voltages up to 1200 v ac, in the same style of case.

•

Mercury Switches

AN ELECTRIC WELD now seals hydrogen gas under pressure in the metal-cased mercury switches of Durakool, Inc, Elkhart, Ind. The closure is stated to keep that pressure intact whether the switch is in use or inactive on a machine or in stock.

Purpose of the hydrogen gas under pressure is to kill the usual arc between the mercury and the contact points of the switch, and to eliminate corrosion of the electrode.

The metal case of the switch acts as one electrode. In the "double flow" model make and break contacts are between two mercury pools, thus further reducing any possibility of corrosion.

Models range from 1 to 65 amp in capacity and are made with or without plastic case as standard equipment. Rubber insulations may be had on order. The rubber insulated switch is water proof to all intents and purposes.

•

Rotary Switch

A ROTARY TAP SWITCH has been developed by the Eastern Specialty Co, Philadelphia 40, Pa. Each switch section with 7 active positions and one off position is rated at 50 amp, continuous duty, with an overload capacity of 75

How PIERCE FUSE SURGE CONTROL SAVES TIME.. CUTS PRODUCTION LOSS!

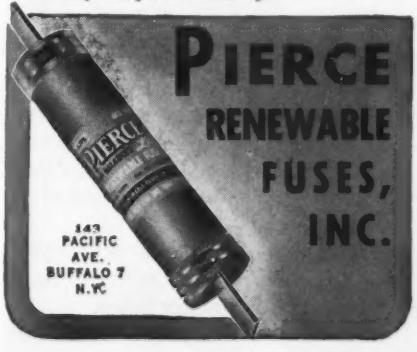
Through a close control of the current surge which results from low or momentary high overload, PIERCE Fuses keep your production line humming. No unnecessary shutdowns . . . no lost labor time . . . no production sag, when PIERCE Fuses are in your plant!

Here's how PIERCE Fuses produce cost-saving Surge Control:

BALANCED LAG LINK — creates more lag at low overloads — where it is necessary and harmless; gives **Safe** lag at high overloads.

SCREEN VENTILATION —takes in cool air and allows escape of heat and gases, reducing unnecessary fuse blowing and banishing dangerous "afterblow".

GET THE FULL STORY of the cost-saving Surge Control features of Pierce Renewable Fuses. Write for descriptive folder--today!



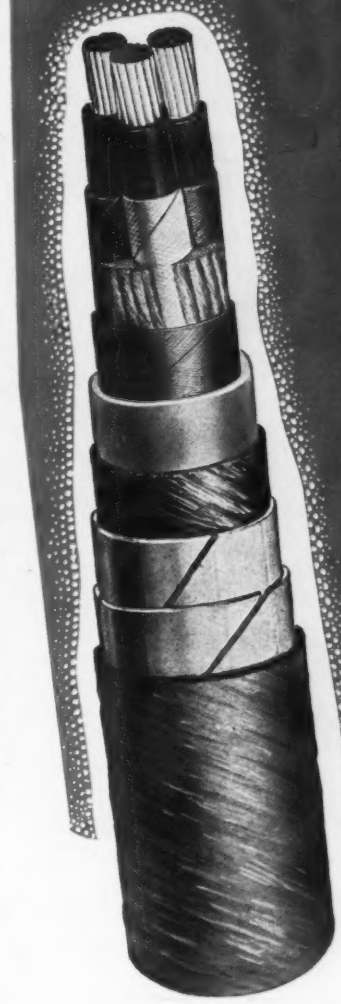
• MAXIMUM PROTECTION AND LONG LIFE •

CRESCENT

Steel Taped

PARKWAY CABLE

in all voltage ranges from 600 to 5000-V with rubber insulation —600 to 8,000-V with varnished cambric insulation For direct earth installation



TYPE RLJFJ
THREE CONDUCTOR

•

Also all standard types of metallic Parkway cables, to I. P. C. E. A. specs. Special cables to customer's specifications.

No other protection required except at points of extreme mechanical hazard. Being well protected from ordinary mechanical injury and easy to install, they provide an economical, permanent underground system.

These cables are widely used for street lighting circuits, railroad yard lighting and signal systems, airport power and lighting circuits and in industrial plants and mines.

CRESCENT INSULATED WIRE & CABLE CO.
TRENTON, N. J.

CRESCENT WIRE & CABLE

NORTH • EAST • SOUTH • WEST • IT'S SCHRAMM

The Air Compressor You Like to Operate

compact . . . no waste space, compressor and engine coupled into a single, rigid, permanently aligned unit . . . balanced to reduce wear and increase efficiency!

lightweight . . . Portables designed for quick handling to and from the job, stationary units vibrationless.

easy to start . . . Just push the built-in electric starter, and the Compressor starts . . . to give you a continuous amount of air.

TOOLS FOR THE JOB

Schramm Inc. also has a complete line of Pneumatic Tools to offer and recommend for operation by their Compressors.

These include Rock Drills, Paving Breakers, Trench Diggers, Clay Spades, Backfill Tampers, Tie Tampers, Sheeting Drivers, Demolition Tools, Chain and Circular Saws.

Write for bulletins and prices.

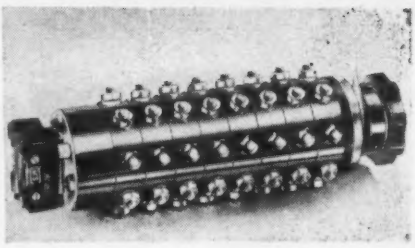
. . . For these reasons users of Schramm Air Compressors have said they *like* to operate both stationary and portable Schramm units.

Other features, however, enter into the usefulness of Schramm. There's 100% water cooled feature, allowing you to operate Schramm perfectly both summer and winter; mechanical intake valve, forced feed lubrication, to mention a few.

Schramm features make them the Air Compressors ideal for your many jobs . . . and the reasons they're specified North, East, South and West. Write today for data.

SCHRAMM INC.

THE COMPRESSOR PEOPLE • WEST CHESTER • PENNSYLVANIA



amp. As many as 12 switch sections in tandem may be operated in parallel to handle a maximum current of 600 amp.

A current interrupter consists of one or two microswitches, rated at 10 amp, and operates by the detent action. It opens the source of power when the switch is rotated toward a new position, so that no arcing occurs at the switch contacts. Due to this non-arcing feature, the circuit in which the switch is used may be high voltage, carrying an inductive load, it is claimed.

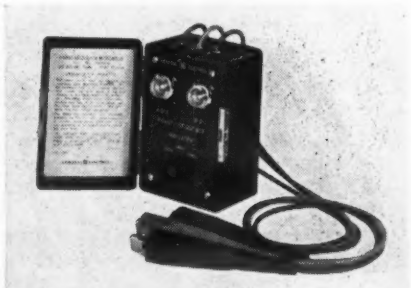
Individual switch sections measure 2½ in. diameter over the housing, 3¼ in. over the terminal studs, length ¾ in. Rigidly mounted, they are made of close fitting impact resistant bakelite moldings, to fully protect all operating parts. Bulletin No. 57 provides operating data.

•

Phase-Sequence Indicator

A NEW PHASE-SEQUENCE INDICATOR designed for a wide range of applications in the manufacturing, industrial, and central station fields has been announced by Meter and Instrument Divisions of General Electric Co.

Having no moving parts, the new indicator is applicable to either 120-, 240-, or 480-v circuits at 25, 50, and 60 cycles. It is housed in a leatherette-covered wooden case, with a cover to protect the two type NE-51 standard neon lamps. Three 30-in. leads are an integral part of the instrument and have clips.



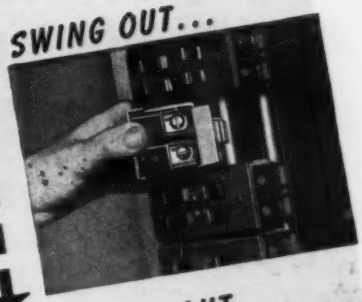
The indicator can be used:

1. To predict the directional rotation of polyphase meters for machine drives, elevators, air-conditioning equipment, and similar equipment.
2. To determine the proper connections for paralleling generators, transformer banks, and power buses.
3. To determine proper connections

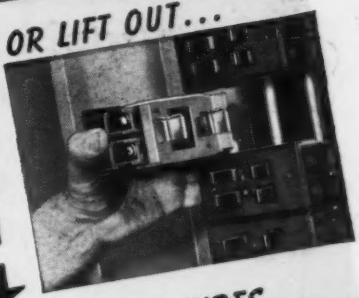
THE NEW NMO "PLUG-IN" PANELBOARD

- ✓ Easy to Wire
- ✓ Simple to Add or Change Circuits
- ✓ Smaller—Yet More Gutter Space
- ✓ New Thermal-Magnetic (Coilless) Multi-breaker Units
- ✓ Application—wherever large number of branch circuits for lights, appliances and business machines must be switched and protected.

1 SWING OUT...



2 OR LIFT OUT...



3 ATTACH WIRES...

4 "PLUG-IN"

Compact, 4-circuit Thermal-Magnetic (Coilless) Multi-breaker units, equipped with positive-pressure contact jaws, grip cylindrical silvered bus bars.

"Plug-in" feature permits easy removal and insertion of units for future changes in circuit ratings or additional circuits if space for expansion is planned.

Low heating, permitting small size, is achieved by exceptionally high silver content in breaker unit contacts, and elimination of bolted current carrying connections.

Smaller size greatly improves utilization of wall and column space. Yet panel has more gutter space (5½" in 15" box) because of compact Multi-breaker unit. Narrow column type has twice number of circuits previously available in cabinets of similar height.

NMO panelboards are furnished with 100 and 200 ampere mains, 120/240 Volt A.C. with 15, 20 and 30 ampere single and double-pole branch circuits.

THERMAL-*Coilless*-MAGNETIC MULTI-BREAKER UNIT PROVIDES 2-WAY CIRCUIT PROTECTION

1. Thermal trip element holds harmless momentary overloads but trips if overload continues.
2. Magnetic element functions instantly on both moderate and heavy "shorts."

ILLUSTRATED NMO *Bulletin* gives complete information on the new Panelboards. Address Square D Company, 6060 Rivard St., Detroit 11, Michigan.

SQUARE D COMPANY

DETROIT • MILWAUKEE • LOS ANGELES

SQUARE D CANADA, LTD., TORONTO, ONTARIO • SQUARE D de MEXICO, S.A., MEXICO CITY, D

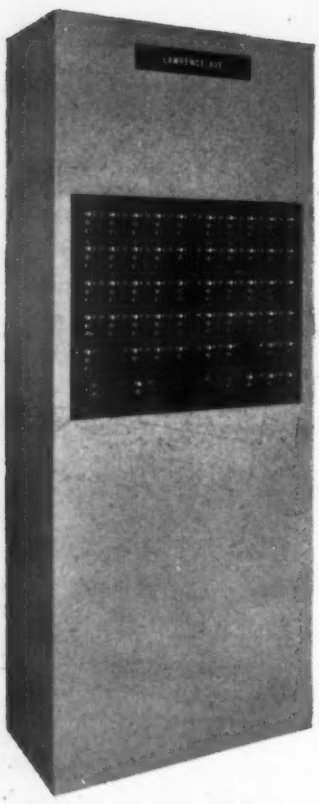
put a 1-2 punch into your Power System

with SUPER-TROL

THE MODERN METHOD OF SUPERVISORY CONTROL

1 Select and Operate

2 See Proof of Operation



A typical Super-Trol Dispatcher's Cubical may be arranged for large or small power systems as required.

With SUPER-TROL just two simple operations provide continuous control of your power system. Put yourself in the dispatcher's place for just a minute. See how simple and reliable SUPER-TROL really is:

- First—you select the operation desired. You may want to open or close a breaker . . . start or stop a remote generator . . . do special telemetering. As you move the selector toggle switch a white light appears. This shows that a change is contemplated. Now you push the operating button. Immediately the frequency signals go out over the remote control circuit and SUPER-TROL goes into action.
- Second—you see positive proof of the completed operation. The white light is out. Colored lights immediately show that the desired operation has been completed. There are no false operations. No guesswork. SUPER-TROL is always accurate . . . fast . . . reliable.

CONSTANT AUTOMATIC SUPERVISION

The SUPER-TROL dispatcher always knows the exact condition of all equipment . . . what breakers are open or closed and where. Indications can be in the form of an electrical map which gives a constant overall picture of your system. If protective equipment opens a breaker, the dispatcher receives both an audible alarm and a visible signal.

Write today for engineering recommendations for your system

CONTROL CORPORATION

719 CENTRAL AVE. • MINNEAPOLIS 14, MINN.

• Super-Trol • Peak-Trol • Telemetering • Battery Chargers • Carrier Current •

for watthour meters, reactive-component meters, power-factor meters, kva meters, reverse-power relays, and phase-sequence relays.

4. To check vacuum-tube, thyratron, rectifier, and inverter installations.

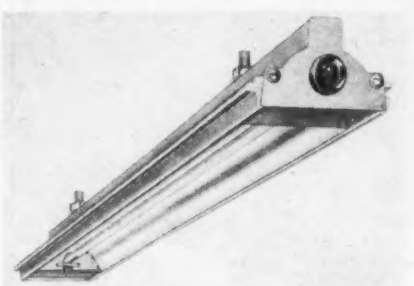
5. To study vector relations of polyphase circuits.

•

All-Metal Radiant Heater

HIGH HEAT intensity and utilization of almost the entire infrared band are featured by the new Chromalox radiant heater. This all-metal, glassless electric heater is manufactured by the Edwin L. Wiegand Co, 7500 Thomas Blvd, Pittsburgh 8, Pa.

The enclosed-type heating element is mounted in an extruded aluminum body at the focus of a parabolic reflector sheet of Alzaked aluminum. A negligible amount of visible light is reported



to be produced from the Inconel-sheathed tubular unit, which operates at temperatures of 1,000 to 1,400 F, depending upon wattage.

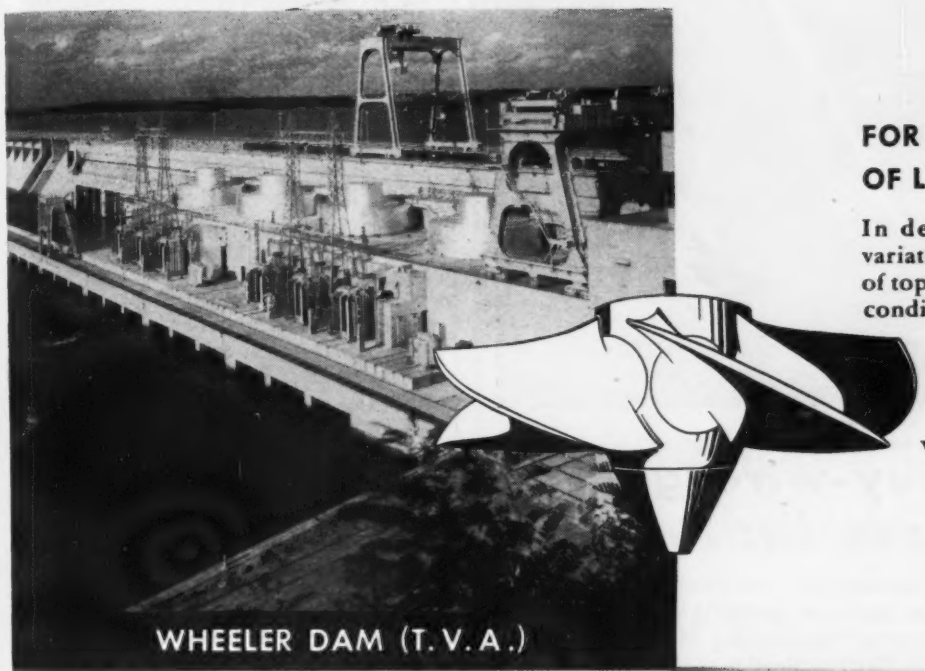
Heating elements can be changed on the job. Various wattages can be provided. Standard body lengths are 25, 31 and 47 in., with respective heated lengths of elements 17, 23 and 29 in.; standard height is only 4 in. Other lengths can be made as required.

•

Pyrometer Controller

DEVELOPMENT of a proportional current-input electronic pyrometer controller has been announced by The Bristol Co, Waterbury 91, Conn. The new instrument is designed to proportion the current input to electrically heated furnaces, ovens, plastic molding machines, salt pots, and other similar equipment to provide practically straight-line temperature control. It does this by time modulation of the input energy. The average energy supplied is proportional to the deviation of the temperature from the control point throughout a band width, which is adjustable from zero to 2½% of full scale reading. The instrument, model IE486, is described in Bulletin PB1237.

HYDRAULIC TURBINE
flow condition



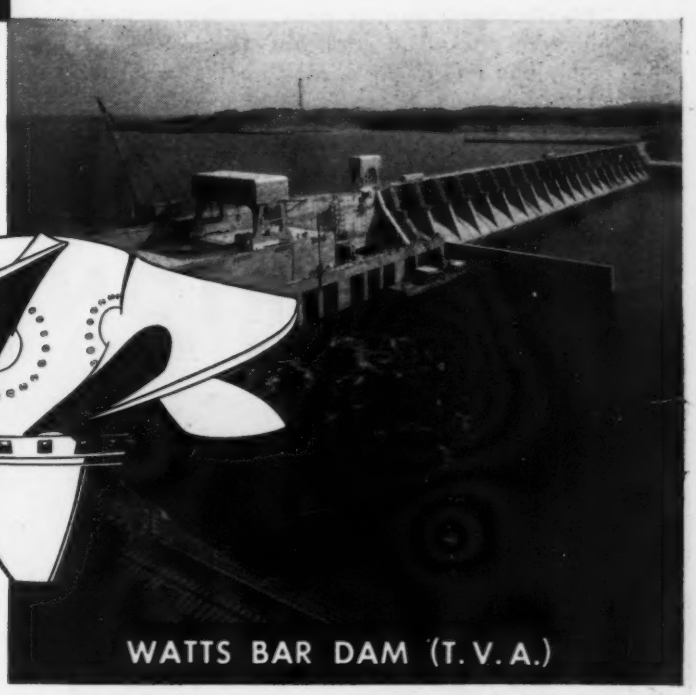
WHEELER DAM (T. V. A.)

FOR ECONOMICAL DEVELOPMENT OF LOW AND MEDIUM HEADS

In developments where there is little variation in head, or where maintenance of top efficiency under widely varying head conditions is not required, Baldwin Fixed Blade Propeller Type Turbines provide an economical solution. Recent impressive installations include the Wheeler Dam of TVA, where four Baldwin 45,000-hp. units are serving, with four more under construction. These are among the largest and most powerful units of this type on the continent.

FOR TOP OUTPUT AT VARYING HEADS

Where (a) medium *varying* heads are involved, and (b) high efficiency is required over a wide operating range, Baldwin Adjustable Blade Propeller units are used. Available in capacities of 100,000-hp. and more, they are serving in some of the country's most famous installations. An indication of flexibility is provided by the Chickamauga TVA development, where units designed to deliver 42,000-hp. at 48-ft. heads must develop at least 20,000-hp. at 25-ft. heads, and 36,000-hp. under 36-ft. heads.



WATTS BAR DAM (T. V. A.)

BALDWIN
HYDRAULIC TURBINES

Offices: Boston, Chicago, Cleveland, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Seattle, St. Louis, Washington. In Canada: Baldwin Locomotive Works of Canada, Ltd., Toronto, Ontario.

SAVE MONEY!

Flexibal wooden guy guards cost less than other types — give full protection longer.

SAVE TIME!

7 foot Flexibal guy guard takes just 2 minutes to install — then lasts for years.

Put Flexibal guy-wire guards on your standards list . . NOW!

Every organization that has standardized on Flexibal guy guards has continued their use. Made of smoothly rounded hardwood and aluminum coated for lasting visibility, Flexibal guy guards provide flexible, lasting protection. They're packed in small easy-to-carry cartons, and there's only one nail to drive. May we send you free trial sample. No obligation of course.

FREE trial set of FLEXIBAL GUY GUARDS

SET of Flexibal guy guards for 7 foot length will be sent at no cost for test. Write on your business letterhead.

S. E. OVERTON CO.

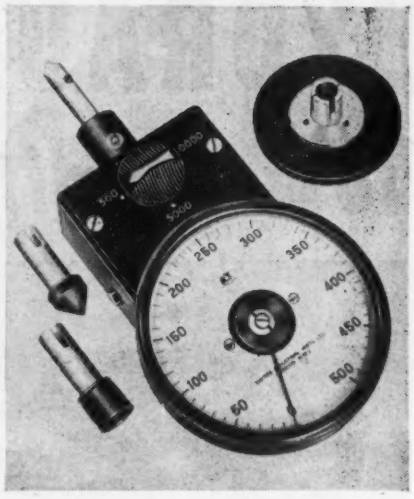
SOUTH HAVEN, MICHIGAN

EASY TO INSTALL

Packed in easy-carry carton, Flexibal guy guards take only a couple of minutes to install. They save you money.

LONG LIFE

Lower first cost, lower installation cost, *and* longer years of trouble-free service make Flexibal the guy guard for you.



Hand Tachometer

A HAND TACHOMETER has been designed with a rocker-arm arrangement so that the instrument pointer always reads in the same direction irrespective of the direction of rotation of the instrument spindle. The tachometer is a recent development by Smiths Industrial Instruments Ltd, and is distributed by Equipoise Controls Inc, 100 Stevens Ave, Mount Vernon, N. Y.

Transmission of the driving spindle rotation to the indicating pointer is effected in the first stage mechanically and in the second stage magnetically. A push-button device is included to arrest the indicating pointer at the indicated reading, similarly to that of a stop watch. By pressing the button on the opposite side of the instrument, pointer returns to zero.

Instrument is made in three models and each model has three ranges. Model ATH4 has a maximum range of 0 to 50,000 rpm or 0 to 25,000 fpm. Instrument accuracy is claimed to read within plus or minus 0.5%.

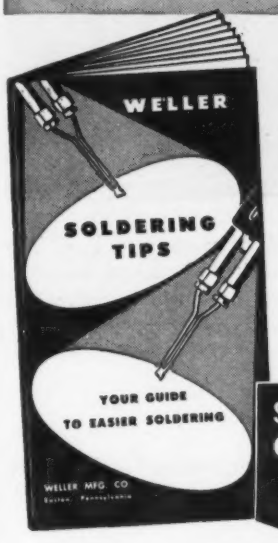
Raceway

ELECTRICAL OUTLETS at either 6 in. or 18 in. intervals are provided by a new plug-in strip manufactured by National Electrical Products Corp, Pittsburgh 19, Pa. The strip can be used for display case, counter, and window installation, also office and appliance services.

Installation is made by joining either 3-ft or 6-ft standard lengths. The 24 gage steel channel and the two No. 12 copper wire conductors "factory-wired" inside the raceway may be cut to fit on the job with a hacksaw at any desired location between the receptacles. Ten matching fittings are also available for any type of installation. When joining the lengths of strip, a copper connector is crimped over the wire ends.

Mounting of the strip is accomplished through the back of the steel channel,

SOLDERING IS A CINCH



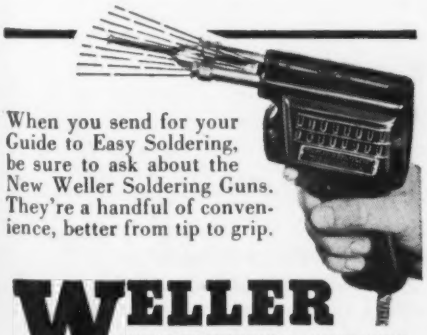
when you know these SIMPLE TRICKS!

SEND NOW ONLY 10¢

No matter how much you know about soldering, there's always a trick that will make it easier. This little 20-page pocket guide is crammed full of such time-and-trouble savers.

Without wasting words, it covers the whole soldering operation—points out DO's and DON'T's—refreshes your memory on difficult points—suggests methods that help you work faster. Yet there's no hard studying, no tough technical talk. Every word is plain everyday English and every point is made clear by easy-to-understand illustrations.

Get this handy Soldering Guide today, and keep it on your bench for ready reference. It's a real handbook of professional soldering—*not* a catalog. Just mail the coupon with 10c cash or stamps and we'll send your copy at once.



When you send for your Guide to Easy Soldering, be sure to ask about the New Weller Soldering Guns. They're a handful of convenience, better from tip to grip.

WELLER
MANUFACTURING COMPANY
817 Packer Street, Easton, Penna.

Weller Mfg. Co., Easton, Pa.

Enclosed find ten cents (10c) for which please send my copy of the Weller "Soldering Tips".

☐ *I am also interested in the new Weller Soldering Guns. Please send Catalog Bulletin.*

*Name*_____

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SORGEL AIR-COOLED TRANSFORMERS

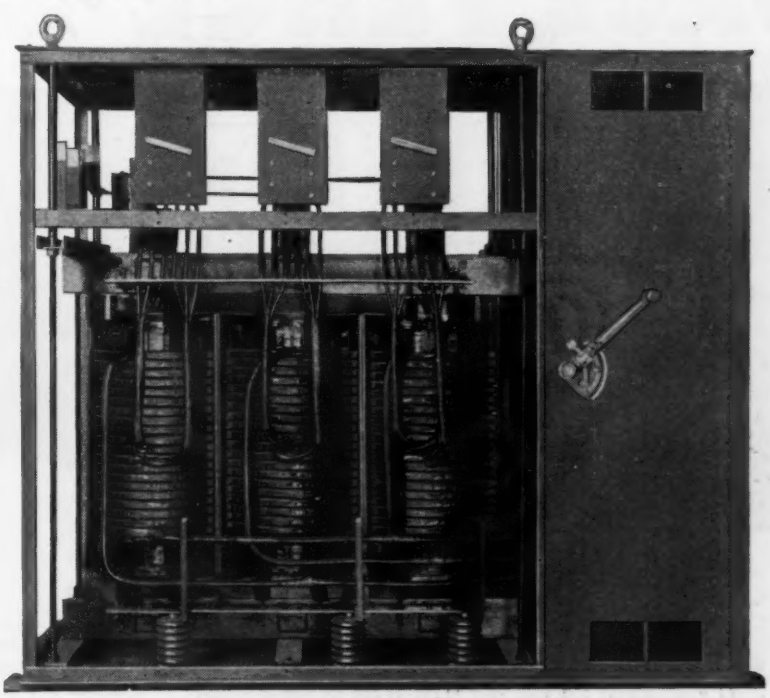
and Complete Unit Sub-Stations

Several advantages of our liberal design are—

Quiet operation
Low temperature
High efficiency
Long life

5 Kva. Single Phase
480/240 to 240/120 Volt
Wall Mounting Type

Designed and constructed for easy installation.
A size and type for every purpose. ¼ to 1000 Kv-a.
All voltages. 115 volts to 15,000 volts.



300 Kv-a. 3-Phase, 13,200 Volt Transformer.
Part of Unit Sub-Station. (Enclosure removed).

SORGEL ELECTRIC CO., 834 W. National Ave., Milwaukee 4, Wis.
Pioneers in the development and manufacturing of Air-Cooled transformers.

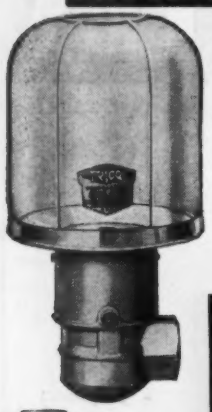
SAFE . . . SURE . . . DEPENDABLE
MAINTENANCE SIMPLIFIED . . . COSTS REDUCED

- Protect Bearings
- Increase Production With

TRICO
REG. U.S. PAT. OFF.

Speed Up Fuse Replacement With

TRICO OILERS



TRICO Automatic Oilers eliminate bearing failures, guesswork, needless shut-downs for hand oiling, damaged materials, accident hazards, and positively reduce operating costs.

WRITE FOR CATALOG

One filling of the reservoir lasts a long time.

FUSE PULLERS

They're SAFE . . . They're handy. TRICO Fuse Pullers provide cheap INSURANCE against accidents and compensation costs.

Pulling fuses by by hand can result in severe injury, shocks, burns, infection and even death.

Handy for adjusting switch & fuse clips.

Recommended by World's leading safety engineers.

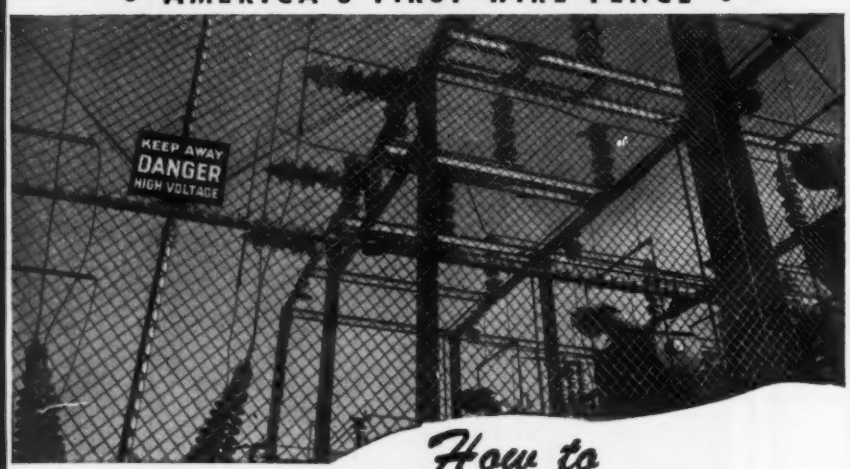
- EVERY ELECTRICIAN SHOULD CARRY ONE.
- HANG ONE AT EVERY SWITCHBOARD
- PLACE ONE IN EACH TOOL KIT AND FUSE BOX.

WRITE FOR BUL. #5

TRICO FUSE MFG. CO.
Milwaukee Wisconsin
FUSES

PAGE FENCE *-Since 1883*

• AMERICA'S FIRST WIRE FENCE •

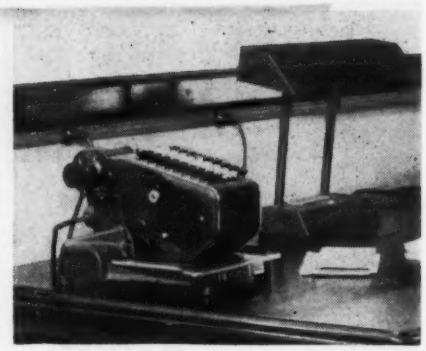


How to Choose the Right Fence

• The right fence for you is made by PAGE, pioneer maker of Chain Link Fence and developer of many major fence improvements. Your fence can be the one of several PAGE styles which is best suited to your needs. It can be had in a choice of metals to give you the one you prefer or require. The nearby Page Fence Association member will confer with you on the fence you need and submit cost estimates without obligation. He is a long-experienced specialist who will erect your fence expertly. Write for illustrated information and we will send name of the member nearest you.

For name of nearest member firm, write to PAGE FENCE ASSOCIATION in Monessen, Pa., Atlanta, Bridgeport, Chicago, Denver, Detroit, Los Angeles, Philadelphia, Pittsburgh, New York or San Francisco

PRODUCT OF PAGE STEEL & WIRE DIVISION OF AMERICAN CHAIN & CABLE • BRIDGEPORT, CONN.



or by streamlined mounting clips. The strip receptacles have phosphor-bronze spring contact clips which make full contact with the plug prongs.

Micrometer

AN ELECTRONIC instrument has been developed for continuous production measurement. It is capable of measuring the dimension of an object which is moving rapidly and vibrating. It is a product of Raymond M. Wilmotte, Inc. 1469 Church St, N. W., Washington 5, D. C.

Two component parts are the measuring head and the indicating and power supply unit. Material is fed past the test apertures of measuring head and illumination is reduced on a photocell. Limit apertures are set to represent the positive and negative tolerance limits. Scanning disk rotates between the apertures and the photocell, exposing each of the three apertures in sequence. As a result of the rotation, three voltage pedestals are fed to an amplifier circuit and to an oscilloscope. The instrument is reported to achieve an accuracy up to plus or minus 0.0001 in.

Building Wire

A NEW and improved type of rubber-covered braided building wire (R, RH and RW) has been announced by Triangle Conduit and Cable Co, New Brunswick, N. J. This new development will be known as "Glazon".

The Glazon building wire is covered with a sheath woven of inert, inorganic fibers of high dielectric strength, finer than a hair. The manufacturer states that these fibers—and the finished sheath—are flexible, much stronger than cotton or rayon, cannot burn, are unaffected by moisture or temperature changes, cannot rot, are immune to all ordinary acids and alkalis and repellent to fungus and rodents. The wire is also smaller in diameter and lighter in weight than conventional building wires. These factors, plus its smooth slick finish are said to reduce fishability problems to a minimum.

THE IMC ENGINEER is

On Your Staff

but not on your payroll

TUNE IN THE ELECTRICAL INSULATION HEADQUARTERS

Because your IMC Engineer represents most of the recognized leading manufacturers of electrical insulation, his experience in this field is unusually complete. He and the IMC organization are qualified to . . .

1. Assist you in the selection of the best insulating material for your job.
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3. Suggest ways to eliminate waste.
4. Help you speed up and increase your production.

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ELECTRICAL IMC INSULATION

* CHICAGO 6, 565 West Washington Blvd.
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MILWAUKEE 2, 312 East Wisconsin Ave.
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REPRESENTATIVES in MINNEAPOLIS 3, 1208 Harmon Pl., and PEORIA 5, 101 Heinz Court

KLEINS

FOR MEN WHO WANT

the Best

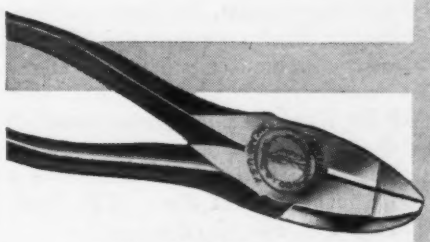
• Ever since the first communication and power lines were strung, Klein Pliers have been the favorite tools of electrical workers.

Today, Klein Pliers are made with the same exacting care that has won these tools their reputation for high quality.

Klein Pliers are still preferred by skilled workers in every field as they have been "since 1857."

No. 201. Original pattern husky Klein Side Cutting Plier. Square nose. Made in four sizes—6, 7, 8, and 9 inches.

No. 242. Klein Oblique Cutting Plier (heavy-duty pattern). A very useful tool that cuts close. Length, 6 inches.



No. 201 NE. The famous "streamlined" Klein Side Cutting Plier. Made in four sizes —6, 7, 8, and 9 inches.

No. 203. Klein Long Nose Plier. Long reach of jaws permits getting into difficult places. Made in 6 and 7-inch sizes.

The Klein Pocket Tool Guide, showing the Klein line and containing useful tool information, will be mailed on request.

Established 1857

Mathias KLEIN & Sons
Established 1857 — Chicago, Ill., U.S.A.
3200 BELMONT AVE. CHICAGO 18, ILL.

NEWS ABOUT PEOPLE

Rankin New President, Rocky Mountain Group

Harold T. Rankin, superintendent of the lighting department of the Public Service Co of Colorado, Denver, who

H. T. RANKIN

was elected president of the Rocky Mountain Electrical League (EW, Sept 25, Page 83), is one of the outstanding illuminating engineers in the West. A leader in the promotion of all branches of modern electric lighting, Mr Rankin was a factor in the introduction of mercury vapor street lighting in Denver and of fluorescent lighting in the West.

Mr Rankin joined the Public Service Co of Colorado in 1920. Since that time he has been identified with every important lighting activity in the Rocky Mountain area. During the recent war he was head of the blackout committee for the state of Colorado. He is a former chairman of the Illuminating Engineering Society, Rocky Mountain chapter, and since 1925 has taken an active part in all phases of the Rocky Mountain Electrical League's activities.

•

▶ ANTHONY F. GRAMM has been appointed electrical supervisor of the Consumers Power Co, Jackson, Mich. He succeeds the late Percy P. Mooney. Mr Gramm began his utility career by working in spare time and during school vacations for the Mt Horeb Heat, Light & Power Co. Following graduation from the University of Wisconsin in 1925, he joined Consumers at the Jackson steam plant. He has been connected with the company continuously since that time. He has served on the general office staff of the electric production and transmission department, engineer in the load dispatching section, construction engineer and as assistant electrical supervisor. In his new position, he will have general supervision over the operation and maintenance of electrical equipment used by the electric production and transmission department.

•

General Electric Elects Johnson Vice-President

Roy W. Johnson has been elected a vice-president of the General Electric Co and continues in his present position as general manager of the affiliated manufacturing companies department.

Mr Johnson became identified with GE in 1930, but nine years later left to join Schick, Inc, of Stamford, Conn. In 1942 Mr Johnson joined WPB and the following year was appointed director of the facilities bureau of that agency. Resigning from WPB in 1944, he rejoined General Electric.

•

▶ FRANK A. STEWART, managing director of the Washington State Public Utility Commissioners Association, has been appointed director of the Washington State Department of Conservation and Development. Mr Stewart moved to Seattle, Wash., one year ago after eight years with the Henry J. Kaiser interests.

▶ DR WARD HARRISON, who recently retired as director of engineering of the General Electric Co's engineering department at Nela Park (EW, Sept 4, Page 27), has joined the staff of Curtis Lighting, Inc, Chicago, as engineering consultant.

▶ J. G. FISHER, superintendent, electrical department, Mississippi State Rating Bureau (Fire Underwriters Bureau) for the past 24 years, has been elected president of the International Association of Electrical Inspectors.

▶ C. T. MESS has been appointed assistant director of public utilities for the California Public Utilities Commission. He is replacing ROY A. WEHE who resigned to become a consulting engineer.

J. M. Dollenmaier Elected Kuhlman Sales Manager

Announcement has been made by the Kuhlman Electric Co, Bay City, Mich., of the appointment of Jack M. Dollenmaier as sales manager. Mr Dollenmaier was formerly connected with the Line

J. M. DOLLENMAIER

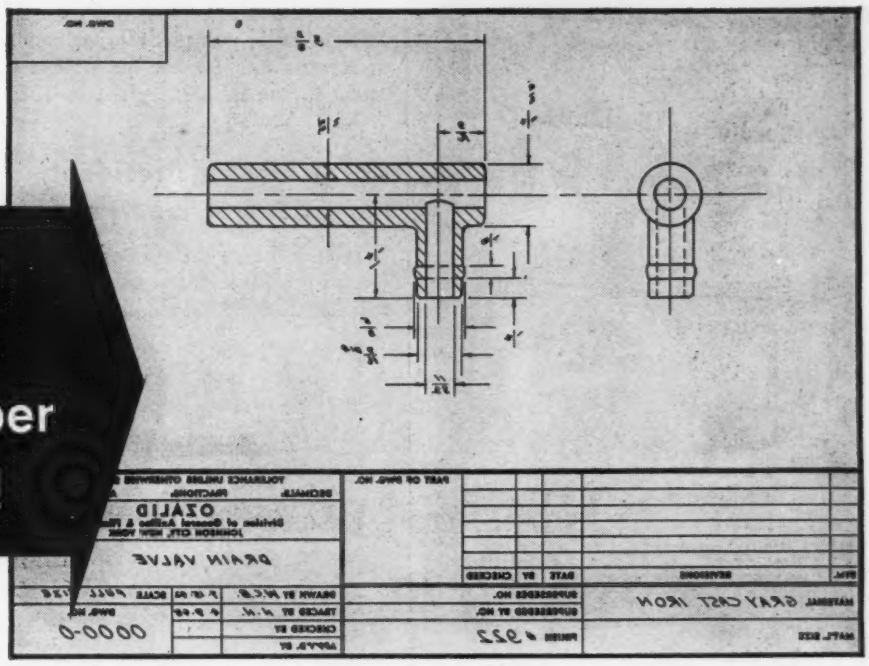
Material Co, at first as sales engineer located successively in several mid-west offices. From 1937 to 1944 he served as district manager of the Detroit and eastern Michigan area. Since 1944 he has been assistant vice-president with headquarters in Milwaukee.

A graduate in electrical engineering of the Armour Institute of Technology (now Illinois Institute of Technology), Mr Dollenmaier received his early training as student engineer with the Public Service Co of Northern Illinois, and as assistant engineer on the Illinois Commerce Commission.

•

▶ HOWARD V. BARR has been appointed superintendent of the Tidd generating plant of the Ohio Power Co at Brilliant, Ohio, and HOWARD R. ANDREWS, superintendent at Tidd since 1945, has been transferred to a similar position at the new Philip Sporn plant now under construction at Graham Station, W. Va. The Philip Sporn plant is jointly owned by Ohio Power Co and the Appalachian Electric Power Co. Joining Ohio Power Co in 1924, Mr Barr served in various engineering positions at the company's Philo plant until his promotion and transfer to Tidd in 1947 as assistant superintendent. Mr Andrews, associated

You're looking at the NEW intermediate paper for mass users!



The drawing above was reproduced on the new Ozalith Intermediate Paper. This duplicate paper original gives you Ozalid prints of maximum line density.

This New Ozalith Paper Costs Little—Has Great Mechanical Strength—Washable, Plastic Surface!

If your operation demands the duplication of a large bulk of drawings and plans, this new Ozalith Intermediate Paper should be of great interest to you.

For it is the answer to the need for a reasonably priced (7½¢ per square foot) paper duplicate original having maximum possible toughness of base; permanence, for filing and record use; and highest reprint quality. It reprints at exceptionally high machine speed.

No Tendency To "Bleed"

The dye image will not offset or transfer to other papers or tracings with which this new Ozalith paper has been placed in contact. There is no tendency to "bleed."

Ozalith is coated on a 100% rag base of great mechanical strength. It will not deteriorate appreciably with age. It is the most durable intermediate paper known.

Pen And Pencil Additions

You can wash Ozalith with a damp cloth—dust, dirt, and grease will come off quickly. Water will not cause the base to cockle or the image to run.

Pen or pencil additions can easily be made on either side of an Ozalith print. Because of its high transparency, contact prints should be made, and additions then made on the unsensitized surface.

Ozalith is a running mate to Ozacloth—but because of its low price, it is ideal for mass users. Write, today, if you would learn more about this and other Ozalid prints.

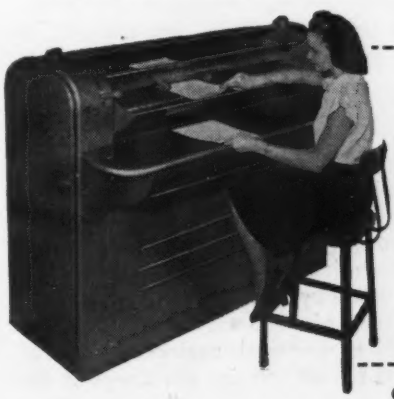
ALL OZALID PRINTS PRODUCED IN SAME MANNER

★ **No tie-ups when you shift from one type of print production to another. Simply choose your Ozalid material . . . and your Ozalid print-making machine exposes and dry develops it. Standard work prints are produced in 25 seconds.**

★ **Your drawings can be up to 42 inches wide, any length. Roll stock or cut sheets can be used. (Special machines accommodate 54" wide drawings.)**

★ **You—or anyone else—can be the operator. A few hours and you're an "expert."**

★ **See *all* the Ozalid prints you may make from any drawing . . . and learn full story. Mail coupon today.**



DEPT. NO. 191

OZALID ... **A Division of General Aniline & Film Corp., Johnson City, New York**

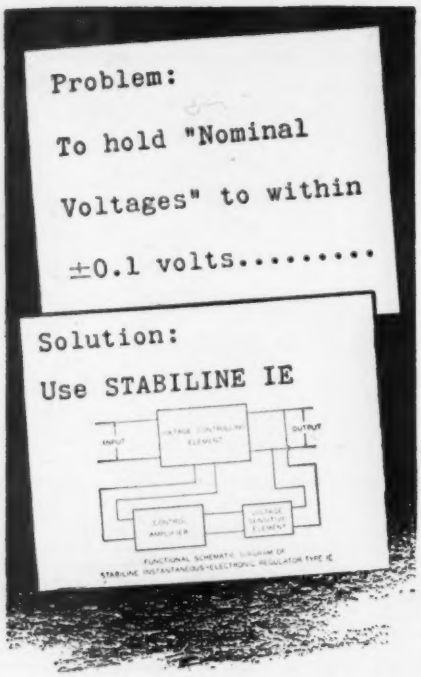
Gentlemen: Please send free copy of Ozalid Streamliner booklet illustrating all types of Ozalid prints.

Name_____ Position_____

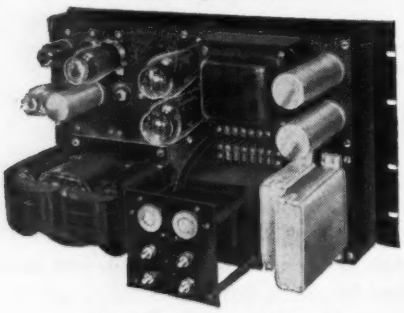
Company_____

Address_____

Ozalid in Canada—Hughes Owens Co., Ltd., Montreal



Your utility company may quote a nominal voltage — but power suppliers are allowed to vary, within certain limits, from the nominal. This condition, plus load changes in your own operation, results in voltages other than nominal. A STABILINE Automatic Voltage Regulator Type IE in your power line assures you of constant voltage. It's *instantaneous* in action — completely *electronic* in operation. Holds delivered voltages to within ±0.1 volts, regardless of line variation . . . within ±0.15 volts for any load current change or load power factor change from lagging .5 to leading .9. Maximum waveform distortion never exceeds 3 percent.



Rear View STABILINE Type IE

Bulletin 547 gives you information on this and other Superior Electric voltage control equipment. Write for your copy today.

THE
SUPERIOR ELECTRIC
COMPANY
510 Meadow Street
BRISTOL, CONN.

with Appalachian Electric Power from 1929 to 1945, was plant superintendent at Kenova and Logan, W. Va, prior to going to the Brilliant plant in 1945.

•

Large Elected President, Central Electric & Gas

Judson Large of Chicago has been named president of the Central Electric & Gas Co, Lincoln, Neb., to succeed Max

J. LARGE

McGraw, who was elected chairman of the board. Mr Large has been in the service of the company and its subsidiaries since 1924, starting his utility career with summer vacations incident to his university training at Dartmouth and the University of Iowa. He was elected secretary-treasurer of the company and its subsidiaries in 1927.

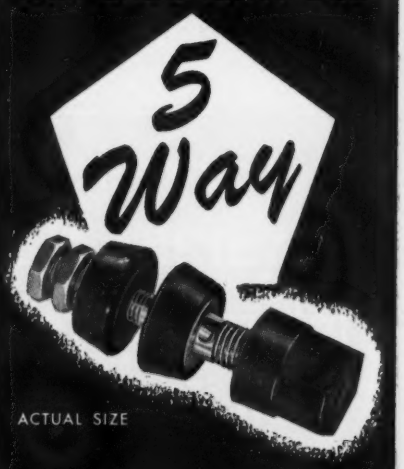
Mr Large is recognized as an outstanding authority on public utility financial matters. In addition to his work with Central Electric & Gas Co, he is also secretary-treasurer and director of the McGraw Electric Co and serves as a director of the Milwaukee Railroad and the Southern Colorado Power Co.

Harold A. Hanson of Lincoln, Neb., has been appointed secretary and treasurer to succeed Mr Large. Mr Hanson left the position of chief accountant with the South Dakota Public Utilities Commission to join the staff of the company in 1928 and has served as general auditor, assistant treasurer, and assistant secretary of the company and its subsidiaries since that time.

•

▶ Col. Rufus W. Putnam, war-time Army Engineer for the Los Angeles District and recently manager at Los Angeles for Kaiser Engineers, Inc., has announced the opening of consulting engineering offices under his own name in that city. Associated with him is a group of engineers and scientists including electrical engineers. For 15 years before entering the Corps of En-

THE SUPERIOR
5 Way



ACTUAL SIZE

BINDING POST
AVAILABLE
NOW WITH
CAPTIVE HEAD

The Superior Electric Company has developed this binding post to give complete insulation, 30 ampere current capacity and 1000 volt working voltage. The captive ½" hexagonal head eliminates fumbling—makes a fast, complete, multi-purpose electrical connector.

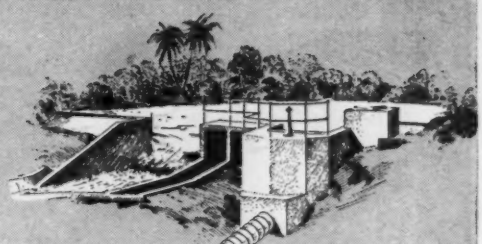
Features Five Connections

1. Permanent clamping of wire up to #12 through center hole.
2. Looping of wire around center shaft and clamping.
3. Plug-in of standard ¾" banana plug.
4. Clip-lead connection by turning hex-shaped head to end of shaft.
5. Spade lug connection.

The 5-WAY Binding Post, available in tough red or black phenolic plastic, is offered for immediate delivery. Write for descriptive literature today.

THE
SUPERIOR ELECTRIC
COMPANY
510 Meadow Street
BRISTOL, CONN.

THE HARNESSING OF ROARING RIVER...

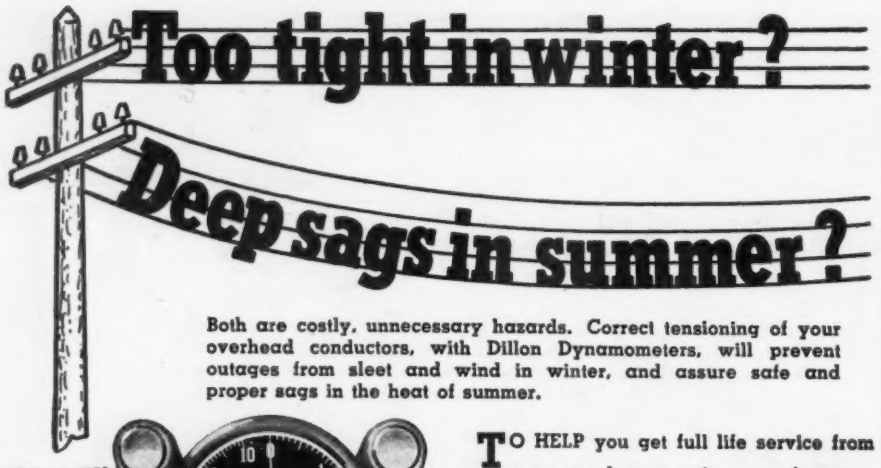


Water is diverted from the source of Roaring River through 6,800 feet of pipe line to a single unit turbo-generator plant where a 520 foot head is converted into 4,500 kva of electric energy. Stone & Webster Engineering Corporation designed the plant and supervised its construction.

The Hydroelectric Development on Roaring River in Jamaica, B. W. I. was designed and constructed for Jamaica Public Service Company, Ltd. to supplement their White River and Bog Walk Hydroelectric Plants. These hydro-power plants make the island largely independent of outside resources in its production of power, relieving the oil burning power plant in Kingston of a large part of its load.

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY OF STONE & WEBSTER, INC.



Both are costly, unnecessary hazards. Correct tensioning of your overhead conductors, with Dillon Dynamometers, will prevent outages from sleet and wind in winter, and assure safe and proper sags in the heat of summer.

TO HELP you get full life service from your conductors, wire manufacturers have spent thousands of dollars determining the exact tension at various temperatures and spans for pre-stretching and installation of their wire. Abiding by their recommendations will lengthen conductor life, and minimize outages when sleet and ice come.

Dillon DYNAMOMETER

TO GET YOUR *free* COPY

of the "Rules of Successful Wire Pre-Stretching and Stringing," written by experienced linemen, drop us a note today.

Dillon Dynamometers are designed specifically for this purpose. They are light, compact, easy to use and accurate.

W. C. Dillon & Co., Inc.

5410-C WEST HARRISON ST., CHICAGO 44, ILL.

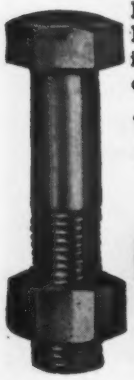
It's HARPER *Everlasting Fastenings*

10 TO 1 OVER COMMON STEEL

RESISTANCE TO RUST AND CORROSION
NON-MAGNETIC
NON-SPARKING
RESISTANCE TO HIGH TEMPERATURES
RE-USABLE

ATTRACTIVE APPEARANCE
EASY TO CLEAN
HIGH STRENGTH
LONG SERVICE LIFE
LOWER ULTIMATE COSTS

} VS. LOWER FIRST COST



Prompt Shipments from Stock . . . Bolts, Nuts, Screws, Washers, Rivets, Accessories . . . Harper maintains stocks of over 5,000 different items in Chicago and New York . . . large quantities of each. Others being added constantly. Specials made to order from ample stocks of new metals.

THE H. M. HARPER COMPANY *Write for Catalog*

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Atlanta, Cambridge, Cincinnati, Cleveland, Dallas, Denver, Detroit, Grand Rapids, Los Angeles, Miami, Milwaukee, Philadelphia, St. Louis San Francisco, Seattle.

HARPER'S 25th Anniversary

HARPER

gineers for the duration of World War II, Mr. Putnam practiced as a consulting engineer in Chicago, specializing in hydraulic, harbor, water terminal, and waterway engineering.

•

H. G. Clum Appointed Sales Manager, Silvray Lighting

Announcement has been made of the appointment of Henry G. Clum as sales manager of Silvray Lighting, Inc, New York, in charge of field sales and promotion.

Well known in the lighting field, Mr Clum brings to his new position a background of 20 years' experience. He was formerly general sales manager of the Art Metal Co in Cleveland in charge of sales, sales promotion, advertising and product engineering. Prior to 1945, he was associated with the Jersey Central Power & Light Co, Asbury Park, N. J., as manager of the lighting sales department.

Mr Clum has participated in the activities of industry associations. He has served as treasurer, chairman of the New York Section, the residence lighting, finance, convention executive committees and general board of examiners of the Illuminating Engineering Society. He is a past-president of the New Jersey Council of Electric Leagues and is a member of the home lighting education committee of the Better Light-Better Sight Bureau.

A. Howard Hasbrook has been appointed manager of the company's quality control and standards department. He will coordinate standards in Silvray manufacturing, finishing, assembly and packing operations.

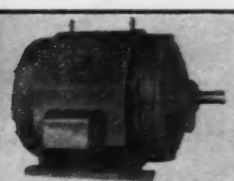
•

▶ Dr William L. Everitt, head of the department of electrical engineering, University of Illinois, has been appointed dean of the college of engineering and director of the engineering experiment station of that university, effective Sept 1, 1949, when Dean M. L. Enger will retire as both dean and director and as professor of theoretical and applied mechanics. During World War II, Dr Everitt served as chief of operational research for the War Department. He is widely known as an electronic engineer and holds several patents in this field. He is also the author of several books and numerous articles on electronics, communications and radar.

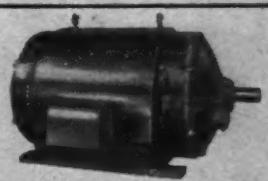
▶ William K. Billow, formerly with the Bonneville Power Administration, has been appointed operating superintendent of the Clark County PUD at Vancouver, Wash. Mr. Billow has been in the electric utility business for 26

1. Rotor shaft is tough steel forging, extra thick through rotor core.
2. Cage bars are oxygen-free copper, silver-soldered.
3. Fans are designed to move large volumes of air with relatively low velocity for quiet operation.

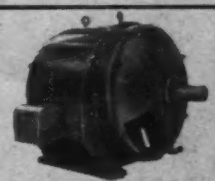
Types of E-M SQUIRREL-CAGE INDUCTION MOTORS



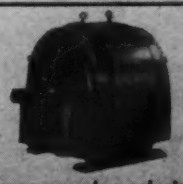
Two-pole; drip-proof; ring lubricated bearings.



Two-pole; drip-proof; pressure-lubricated bearings.



Four or more poles; drip-proof; sleeve bearings.



Four or more poles; splash-proof; ball bearings.

EXTRA VALUE CONSTRUCTION MAKES THE DIFFERENCE

● Yes . . . there are big and important differences in big motor engineering. You see them in the indestructible rotor construction of the E-M Squirrel-Cage Induction Motors. You see them also in the long-life insulation of these motors, their cool-running, wear-resistant bearings and their motor protection. They are differences that make E-M Heavy-Duty Induction Motors exceptional values. Write for our publications 189 and 190 giving full details.

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BIG MOTOR ENGINEERING

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The 7-Range Clip-On Volt-Ammeter

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Offers These Important Advantages

- Measures up to 1000 amps—up to 600 volts.
- Convenient ONE HAND operation trigger action.
- Thumb operated range selector switch.
- 7 ranges—5 current and 2 voltage.
- Insulated core—shockproof construction.
- Takes cables up to 2¼" diameter.
- Distinct calibrations—easy to read.
- Suitable for 50-70 cycles.

RANGES: 0-10 *amps;* 0-25 *amps;* 0-100 *amps;* 0-250 *amps;* 0-1000 *amps;* 0-150 *volts;* 0-600 *volts.*

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We put a lot of careful workmanship into the production of all Sherman Soldering Lugs. Dimensions are held to consistent accuracy. Lugs are kept free from burrs, corrosion, etc., and special attention is devoted to maintaining FLAT contact surfaces. All lugs individually inspected before shipment.

H. B. SHERMAN MFG. CO.
Battle Creek, Mich.

Sherman
SOLDERING LUGS

years, starting with the Denver Gas & Electric Co and remaining with its successor, Public Service Co of Colorado. Other positions have included that of assistant electrical engineer, Imperial Irrigation District, Imperial, Calif.; resident engineer with the REA in Iowa and later associate engineer with REA in Washington, D. C. and more recently electrical engineer with BPA in Portland.

OBITUARY

▶ THOMAS B. STILLMAN, engineering consultant for Babcock & Wilcox Co, New York, died suddenly in Philadelphia on Sept. 28. He was 58 years old. An internationally known authority in the field of fuel-oil burning equipment and marine-boiler design, Mr Stillman held more than 25 patents relating to boilers, superheaters, oil burners, and economizers. He was graduated from Stevens in 1911 with the degree of mechanical engineer. He joined B&W as an apprentice engineer and was assigned to the marine department. He became application engineer in 1931 and engineering consultant at the beginning of this year. Mr Stillman was a member of the American Society of Mechanical Engineers and of other engineering societies and a fellow of the American Association for the Advancement of Science.

▶ LOUIS COHEN, engineer consultant and inventor of many devices in radio and cable telegraphy, died on Sept 28 of a heart attack at his home in Bethesda, Md., at the age of 72. Since joining the Bureau of Standards staff in 1905, Mr Cohen had become internationally known for his researches into radio and telegraphy. During the first World War he developed for the Navy an instrument that became known as the Cohen receiver. Later he served on several international commissions on communications, and wrote technical books and papers in the general field of electricity. Mr Cohen was born in Kiev, Russia, in 1876. While practicing as a consulting engineer, he received many public assignments. In 1921 he was a United States delegate to the International Conference on Electrical Communications in Paris.

▶ RAYMOND E. PATTEN, director of design of the General Electric Co's appearance design division and an outstanding industrial designer, died in Norwalk, Conn., on Sept 13. He was 51 years old. Mr Patten had been associated with the electrical industry since 1928, and with GE since 1930, when he was named head of the design and planning department of the company's Kitchen Institute.

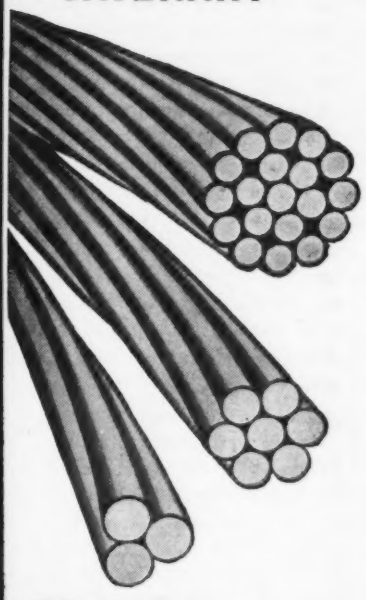
PAGE

Stainless Steel

STRAND

for

GROUND
GUY
MESSENGER
CATENARY



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in Corrosion Resistance
Tensile Strength
Elastic Limit
Resistance to Vibration
Strength to Weight Ratio

Lower

in Cost per Year
of Installed Life

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AMERICAN CHAIN & CABLE

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While your town sleeps...

this load-builder works—for you!

And look!

Two General Electric Automatic Blankets equal the kilowatt-hour load of one six-foot refrigerator!

General Electric Automatic Blankets boost your load when you need it—*from midnight to morning!*

And right now is your chance to make the most of this off-peak load builder—by tying in with those big selling months—November and December!

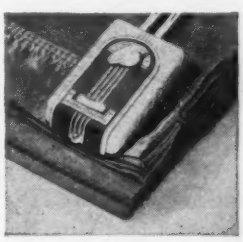
Feature the Automatic Blanket in your advertising and promotion. Tell your customers what a wonderful Christmas gift it is!

Tell them about the all-night coziness of General Electric Automatic Sleeping Comfort. (Already, more than half a million people are praising this wonderful way to sleep snugly under *one* light cover, even on wintry nights.)

To back you up, we're running beautiful four-color pages in *Life*, *House Beautiful*, *Good Housekeeping*, *National Geographic*, including a special Christmas gift ad.

And there'll be frequent mentions on "The G-E House Party," coast-to-coast air show over CBS.

For full information about this great off-peak helper (including enthusiastic statements from leading utility executives), write at once to Appliance and Merchandise Dept., General Electric Company, Bridgeport 2, Connecticut.



Automatic Blanket

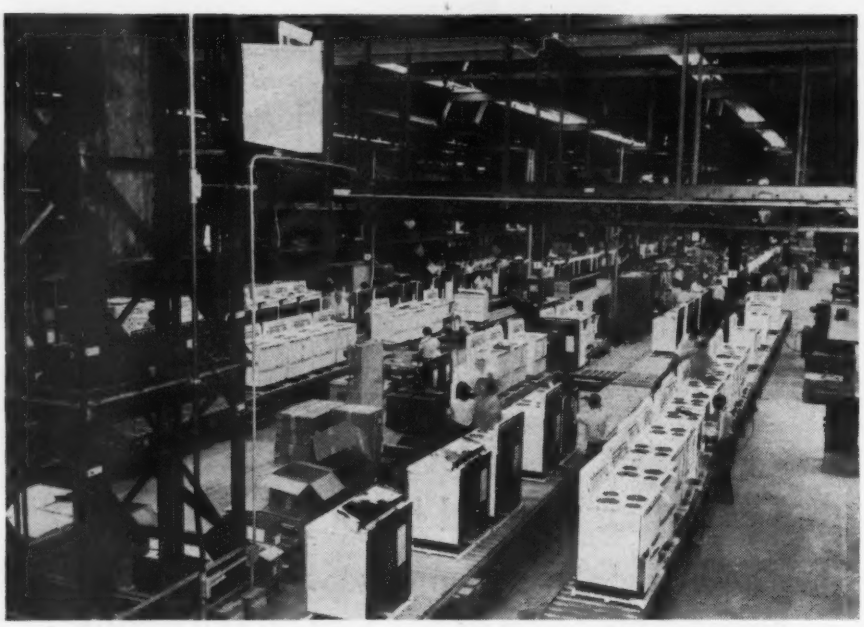
"Goes to work when the lights go out"

Approved by Underwriters' Laboratories, Inc.

Certified washable by American Institute of Laundering.

GENERAL ELECTRIC

MANUFACTURERS and MARKETS



OVERHEAD VIEW of the four main assembly lines in Hotpoint's new electric range plant shows pushbutton ranges moving through inspection stations on the way to the warehouse for crating and shipping. Completed ranges are lifted by elevators at left and carried by overhead conveyors to the warehouse. Finished range can be seen at top of elevator

World's Largest Electric Range Plant Opened by Hotpoint, Inc, at Chicago

The world's largest electric range plant, occupying 1,000,000 sq ft of manufacturing space, has been opened for formal operations by Hotpoint, Inc, in Chicago. Beginning of formal production marks the completion of the "greater Hotpoint program," which required an investment of more than $20 million in new facilities.

The company's latest development—the pushbutton electric range—is being produced by the new plant. Rated capacity is 600,000 ranges a year.

Latest mass production techniques are incorporated. All machinery is single-purpose type, designed to speed output in assembly line operations. Housing of unloading and shipping operations under one roof, fluorescent lighting, and labor-saving equipment set new standards of working conditions.

Seven miles of conveyors channel range sub-assemblies and parts to four main range assembly lines, designed for maximum flexibility in changing from one model to another without interrupting the plant's over-all output. Ranges, after passing inspection stations on the final assembly lines, are lifted by elevator to overhead conveyors and emerge in the warehouse ready for crating and shipping.

A piece of steel arriving at the new factory in the morning reaches the warehouse as a completed range the same day. The plant will unload 16 railroad cars of incoming materials and ship 32 cars of ranges daily at peak operations. The warehouse also is equipped with ramp facilities to accommodate seven trucks for local deliveries.

The plant contains a complete range-finishing department, described by company engineers as the most modern in the industry. Overhead conveyor lines above the enamel room can store parts for 800 ranges.

Many phases of fabrication are performed by especially designed equipment providing, engineers report, a degree of automatism never before approached in the manufacture of electric ranges.

Typical of this equipment is a 450-ton Verson range drawer press. The machine, only one of its kind in the world, was designed by Verson Allsteel Press Co, in conjunction with Hotpoint engineers. Cold roll stock is fed automatically from a coil cradle through a stock straightener into the huge press. The first of eight dies in the press blanks out the stock, which then proceeds through consecutive stages of drawing, trimming, forming, and bead-

DISTRICT SALES MANAGERS and district engineers of the new Electrical Products Division of American Steel & Wire Co gathered for their first meeting. Left to right, seated: C. M. Vaill, Eastern District manager, New York; T. F. Peterson, manager of sales; C. H. Eisenhardt, assistant manager of sales. Standing, C. H. Currier, New England District manager, Boston; C. E. Plass, engineer, and R. A. Coates, Western District manager, Chicago; V. W. Heimberger, Central District manager, Cleveland; W. P. Lewis, Central District engineer; and H. E. Purdy, Eastern District engineer

NEW PERFECTION POST HOLE DIGGER

DURABLE:
Blade and shank forged in one piece from a bar of steel. Heat treated for maximum toughness. Handles, extra strong select ash. Top section shaped for easy hand grip. Blades attached with hardened steel bolts.

EFFICIENT:
Balance is perfect. Properly distributed weight drives sharpened blades easily into any soil. Blades hold edge because of tough heat-treated steel.

TOP VALUE:
Unexcelled because of construction and efficiency. Manufactured by The American Fork and Hoe Company, Cleveland, O., Makers of True Temper Products.

STURDETOOLS
a **TRUE TEMPER** **PRODUCT**

Perfection Post Hole Digger No. 443. Heavy duty model. Forged steel heat-treated blades 12" by 7" in size. 11 gauge weight, sharpened edges. Select ash handles, 8 ft. long, smooth, sanded and lacquered. Address inquiries to distributor.

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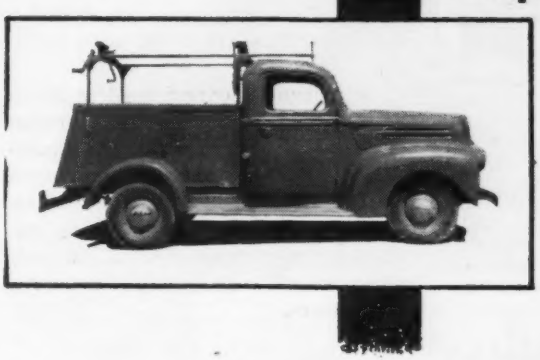

and YORK-HOOVER BODIES are being *re-ordered* by operators everywhere

Because they can count on specific purpose design, because they get dependability, because, through honest workmanship, they get low maintenance costs—operators come back to York-Hoover with re-orders time and time again. They've experienced the over-all *reliability* of York-Hoover Bodies and they want "more of the same."

This steady increase in customer approval of York-Hoover Bodies is the result of *sound engineering* and *fine craftsmanship,* factors which have kept York-Hoover a leader in the production of quality truck bodies for more than 55 years.

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Silicone News

DC SILICONES

SILASTIC* INSULATED WIRE AND CABLE

Now Available for High Temperature High Voltage Applications

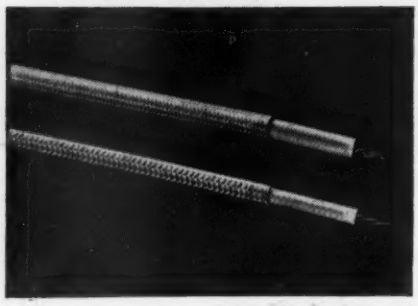

PHOTO COURTESY THE OKONITE COMPANY

Silastic is extruded over wire and cable ranging from No. 18 to 500,000 circular mils in size to provide insulation having maximum resistance to heat, ozone and weathering.*

Silastic* has been chosen to insulate the new line of heat-stable "Okotherm" wire and cable made by the Okonite Company of Passaic, N. J. Silastic* insulation maintains its high dielectric strength even after continuous long time exposure to temperatures as high as 200° C. (400° F.). Its dielectric loss factor is low compared with that of organic rubbers.

Silastic* insulation is practically unaffected by corona or ozone. A severe corona resistance test of Silastic 181 for example, was discontinued after more than 4000 hours without breakdown. The best organic rubber insulating materials break down under this same test in 50 to 150 hours.

Silastic* insulated wires and cables withstand severe outdoor weathering without deterioration because of exceptional water repellency, low moisture absorption, resistance to oxidation and ozone, and good flexibility at low temperatures. Serviceable operating temperatures are in the range of —80° to +400° F.

These properties plus good resistance to a variety of chemicals and hot oil are now available to you in Silastic* insulated wire and cable. Among the many high temperature applications for Silastic* insulated wire or cable are: power plant wiring and lead wire for electric ovens, furnaces and motors.

Other applications include wiring for high intensity floodlights and street lights, and as high voltage ignition and neon sign cable. Our specifications for Silastic* insulated wire and cable are given in pamphlet No. G 6-B.

*TRADEMARK DOW CORNING CORPORATION

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Atlanta • Chicago • Cleveland • Dallas
Los Angeles • New York
In Canada: Fiberglas Canada, Ltd., Toronto
In England: Albright and Wilson, Ltd., London

Dow Corning
FIRST IN SILICONES

ing. At each stroke of the press a completed range drawer emerges ready for cleaning and finishing.

A battery of four Bliss presses was especially designed to perform completely automatic range body fabrication. Fifteen tons of sheet steel are fed by a Dexter feeder through a roller to a slitter for trimming. Carried by a pickup conveyor, the steel then is fed to the four presses that form the range bodies.

Despite materials shortages, the new plant was completed on schedule in 15-months.

•

U. S. Testing Adds 50-C Generator to Facilities

To meet a demand from exporters of electrical equipment, the engineering division of the United States Testing Co, Inc, Hoboken, N. J., has added a 50-c, 120-v, 2-kw generator to its facilities.

The difficulties experienced in South America and other foreign countries which operate on lower power frequencies than in this country, create interest in this service for manufacturers of refrigerators, room coolers, washing machines and some types of fans. This new equipment will also be used for testing transformers.

•

Ups Transformer Prices

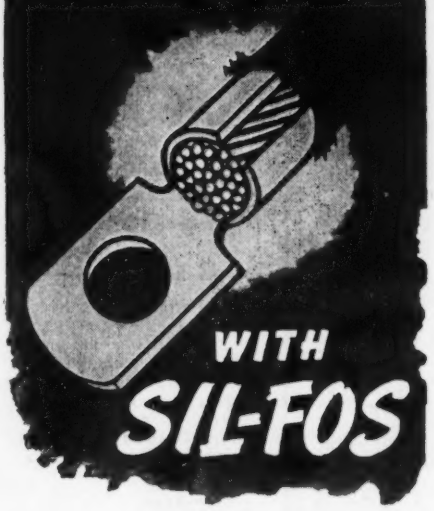
Allis-Chalmers Manufacturing Co has announced price increases on oil-immersed, self-cooled and chlorextol liquid-immersed distribution transformers above the 15 kv-class, power transformers, network transformers, and on all three-phase step feeder voltage regulators. List prices on distribution and network transformers have been raised approximately 10%; step-type voltage regulators, approximately 6 to 7%; and power transformers, about 5%. Price increases have also been announced for the company's unit substations and vary with the different ratings. The new prices are effective immediately.

•

Cites Monsanto Report

In the final ratings of an independent board of judges for the "Financial World" annual report survey, Monsanto Chemical Co was judged as having the best 1947 annual report of the chemical industry. More than 4,000 corporation annual reports were submitted in this national survey, eighth in the series. The trophy will be presented to William M. Rand, president of Monsanto, at the annual awards banquet at the Hotel Pennsylvania in New York on Oct 21.

BRAZE ELECTRICAL CONNECTIONS



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HIGH CONDUCTIVITY
ONE-PIECE STRENGTH
PERMANENT TIGHTNESS
FAST PRODUCTION
SURPRISING LOW COST
NO MAINTENANCE

Whether you have only a few electrical connections to make, or thousands — there's no simpler, faster, more economical way to make them than brazing with SIL-FOS. That goes for terminals, lugs, leads, coil windings, bus bars or any other copper connections. Actually, connections made with this fast-acting, low temperature silver brazing alloy, *equal the unjoined metal* in all properties you need in electrical connections.

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how to plan rate structures that attract new capital

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To provide adequate earnings in the face of

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- growing plant investments with higher new money costs
- expanding and changing loads

THE SOLUTION:

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...now that

KOPPERS CREOSOTE

is plentiful again!

IF you need creosote for pressure-treating wood, just send an SOS to Koppers, and we'll ship your requirements. And you'll look just as happy as the man above, because you'll get the same high-quality Koppers Creosote you've always known.

When you order Koppers Creosote (or Koppers Creosote-Coal Tar Solutions), it's important to remember that you're getting products that have decades of dependable performance behind them . . . that have established enviable records as wood preservatives everywhere.

Send in your order now. And if you want to *play safe*, ask about Koppers yearly contracts that take care of your future needs.

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All Standard Specifications For All Types of Wood Preservation

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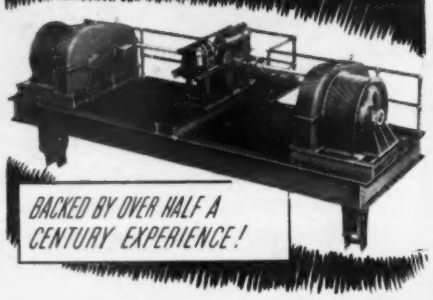
WHEN YOU PLAN POWER DAM PROJECTS
ASK US ABOUT
GATES & GATE HOISTS



Murray Gate Hoists are designed and built to meet all requirements . . . from the smallest hand operated to large motor operated—a wide range of capacities from less than 1 ton to over 100 tons. During our nearly half a century of designing and building gate hoists we have developed various designs for the different types of gate hoist problems. We feel sure we have designs and patterns that will fit your requirements.

We also build gate hoists entirely from your plans and specifications, if desired. In planning gates or gate hoists it is suggested you communicate with us before your plans for the project as a whole are completed . . . it will save expense and much preparation time.

Our engineering department is at your service any time to help solve problems involving this type of equipment.

MURCO D. J. MURRAY MANUFACTURING CO.
WAUSAU WISCONSIN

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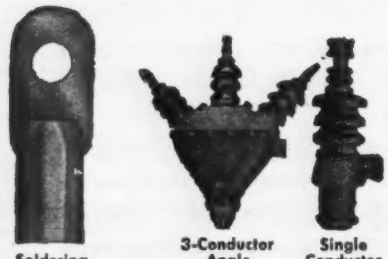
FOR HEAVY INDUSTRIAL SERVICE
RMC
FROM STOCK



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NEW ELECTRICAL CONSTRUCTION

NEW ELECTRICAL construction projects announced by private and government utility systems involving more than $70,000. Also listed are major industrial and construction jobs where electrical work is included

UTILITIES

Proposed Construction

Arkansas—First Electric Co-operative, Jacksonville, imprv., exten. rural distr. lines, Pulaski Co. **$850,000.**

Fla., Jacksonville—City, electric equipment for Power Plant 2, Reynolds, Smith & Hills, 227 Park St., engrs.

Georgia—Coweta-Fayette Electric Membership Corp., Newman, 100 mi. rural distr. lines, Coweta and Fayette Counties. **$110,000.** J. B. McCrary Eng. Co., Corp., 22 Marietta St. Bldg., Atlanta, engrs.

Illinois-Missouri—Union Electric Co. of Missouri, 315 N. 12 Blvd., St. Louis, Zone 1, 12 mi. two steel tower transmission lines, incl. aerial crossing of Mississippi River between Cahokia Power Plant, Cahokia, Ill., and point on west bank of river, vicinity Davis St., St. Louis, Mo., thence to Shrewsbury, St. Louis Co. **$500,000.** Stone & Webster Eng. Co., 49 Federal St., Boston, Mass., consult. engr.

Illinois—Menard Electric Co-operative, A. E. Becker, mgr., Petersburg, rural distr. line extens., imprvs., in Menard, Cass and Morgan Counties. **$919,000.**

Indiana—Marshall County Rural Electric Membership Corp., Plymouth, 10 mi. rural distr. lines, sys. imprvs., Marshall Co. **$190,000.**

Iowa—Humboldt County Rural Electric Co-operative, Humboldt, sys. imprvs., etc., Humboldt Co. **$203,000.**

Kentucky—Shelby Rural Electric Co-operative Corp., Shelbyville, 120 mi. rural distr. lines, sys. imprvs., Shelby Co. **$400,000.**

Louisiana—Southwest Louisiana Electric Membership Corp., Lafayette, 180 mi. rural distr. lines, Lafayette Co. **$255,000.**

Mich., Detroit—City, City Hall, 42 x 56 ft., brick, steel power plant, also altering a generator room in Aquarium Bldg., etc., Contr. PR-55. Plans deposit $15. G. R. Thompson, Griswold Bldg., city engr.

Minnesota—Crow Wing Co-operative Power & Light Co., Brainerd, 318 mi. rural distr. line, sys. imprvs., headquarters, facilities, incl. office bldg., warehouse, Crow Wing Co. **$625,000.**

Minn., Minneapolis — Radio Station WDGY, M. E. Drake, mgr., Nicollet Hotel, plans by R. C. Chapin & D. J. C. Parsons, 604 Wesley Temple Bldg., eight 220 ft. towers, about 50 x 60 ft. bldg., Lyndale and Humboldt Aves. South (in Bloomington) and Minnesota River. **$450,000.**

Missouri—Northwest Missouri Electric Co-operative, Savannah, rural distr. lines, sys. imprvs., Andrew Co. and vicinity, **$962,500.**

North Dakota — Bureau Reclamation, Dpt. Interior, Bldg. 1-A, Denver Federal Center, Denver, Colo., 1,500 kva. substation at Watford City, Transmission Lines Unit, Missouri Basin Proj., Spec. 2424.

Ohio—Midwest Electric, Inc., St. Marys, sys. imprvs. and 21 mi. electric distr. line, Auglaize Co. **$195,000.**

O., Youngstown—Republic Steel Corp., Republic Bldg., Cleveland, electrify Bessemer plant, install two 6,000 hp. electric motors and controls, etc., substations.

Oklahoma—Choctaw Electric Co-operative, Inc., Hugo, 254 mi. rural distr. lines, sys. imprv., completing previously approved constr., Choctaw Co. **$475,000.**

Pa., Cresson — Dpt. Property & Supplies, 18 and Herr Sts., Harrisburg, power plant alterations, addns., at Tuberculosis Sanatorium No. 2. $300,000. Plans denosit $7.50. G. Arthur Danielson, 209 Hayes Bldg., Erie, engfir.

Pa., Phila.—Phila. Electric Co., 900 Sansom St., electric transformer substation. $75,000.

South Dakota — FEM Electric Assoc., Ipswich, 584 mi. rural distr. lines, completing previously approved construction, Edmunds Co. **$920,000.**

Texas—North Plains Electric Co-operative, Inc., Perryton, sys. imprvs., 395 mi. rural distr. lines, Ochiltree Co. **$582,000.**

Texas — Medina Electric Co-operative,

FOR QUICKER EASIER TRIMMING WORK
use SEYMOUR SMITH TOOLS...
TREE TRIMMERS
POLE SAWS
BRUSH CUTTERS
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A line of tools designed for linemen's use that are standard equipment with the world's largest Utility Companies.
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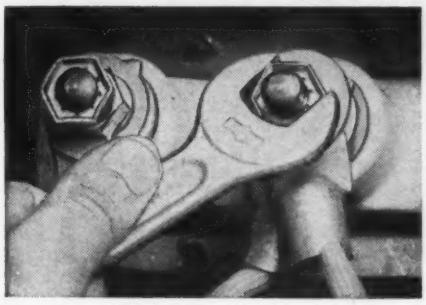
Experts in Metal Fabrications since 1886

Stewart IRON and WIRE FENCES

PALNUTS* Keep Terminal connections Permanently Tight



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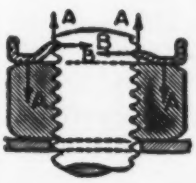
Double Locking Action



Arched, slotted jaws grip the bolt like a chuck (B-B), while spring tension is exerted upward on the bolt threads and downward on the regular nut (A-A), securely locking both.

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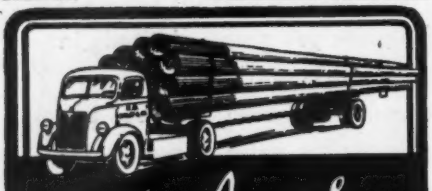

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Hondo, 500 mi. rural distr. lines, sys. imprvs., 2-way radio communication sys., Medina Co. $650,000. Wm. Orrison Engineers & Assoc., 215 Travis Bldg., San Antonio, engrs.

Tex., Port Lavaca—Aluminum Co. of America, Port Lavaca, electric power plant. $350,000.

Washington—Skagit Public Utility Dist., Mount Vernon, rural distr. line from Mt. Vernon to Anacortes, Skagit Co. **$750,000.**

Washington—Bureau Reclamation, Dpt. Interior, Bldg.-1-A, Denver Federal Center, Denver, Colo., furnishing, del. f.o.b. cars shipping point or f.o.b. cars Odair, three 165,000 h.p. 120 rpm. vertical-shaft, hydraulic turbines, 3 all-pressure cabinet-type governors with pumping equip. for regulating speed of 165,000 h.p. turbines for units R7, R8 and R9, Grand Coulee Power Plant, Columbia Basin Proj., Spec. 2425.

Wyoming and Nebraska—Bureau Reclamation, Dpt. Interior, 504 Conroy Bldg., Casper, Wyo., Casper-Gering 115 kilovolt transmission line, Transmission Lines Unit—Wyoming-Nebraska, Missouri Basin Proj., Spec. 2423.

Low Bidders & Contracts Awarded

Ala., Birmingham — Radio Stations WSGN & WAFM, c/o contractor, radio station, to Brice Building Co., 1021 2 Ave. N., **$148,500.** Bids 9/21.

Calif., San Francisco—City and San Francisco Co., P. Utilities Comn., City Hall, overhead wiring on McAllister and Hayes Trolley Coachline, west of Franklin St., Spec. 316, from Severin Electric Co., 249 Natoma St., **$220,090.**

Florida — Clay Electric Co-operative, Inc., Keystone Heights, 581 mi. rural distr. lines in Clay Co., to Leo T. Barker, Moultrie, Ga., **$584,250.** Bids 9/16.

Georgia—Hart County Electric Membership Corp., Hartwell, 251 mi. electric distr. line, Hart Co., to Alrich Elec. Constr. Co., Augusta, **$244,669.** Marcus C. Long, Alma, engr.

Ill., Chicago—City, Dpt. Purchases, Supplies & Contrs., City Hall, Sept. 16, Dearborn St. Subway, Contr. T-13B, from Westinghouse Electric Corp., 20 N. Wacker Dr., **$100,431.**

South Carolina—Horry Electric Membership Co-operative, Inc., P. S. Page, pres., Conway, Sept. 20, 148.92 mi. rural distr. lines, Horry Co., from Sumter Buildings, Inc., Sumter, **$209,536.**

Tenn., Pulaski—Pulaski Light & Water Dpt., Pulaski, electric power lines, to Hagan Powell, c/o Wm. M. Wilson, engr., Box 24, Shelbyville, **$147,296.** Bids 8/10.

INDUSTRIAL, COMMERCIAL & PUBLIC BUILDINGS

Proposed Construction

Mich., Dearborn—John Hancock Mutual Life Insurance Co., 197 Clarndon St., Boston, Mass., 1,200 unit housing, garden community type. Approx. **$10,000,000-$25,000,000.**

Mass., Roxbury—Veterans Admin., 55 Tremont St., Boston, plans by Coolidge, Shepley, Bulfinch & Abbott, 1 Court St., Boston, 14 story hospital on 13 acre site, S. Huntington Ave. and Heath St. **$20,000,000.**

Pa., Penn Valley (P.O. Gladwynne)—Home Life Insurance Co. of America, Inc., 506 Walnut St., Phila., plans by Harrison, Ballard & Allen, 123 E. 77 St., New York, N. Y., apartment development, Conshocken Rd. and Hagy's Ford Rd. **$5,000,000.**

Pa., Cheltenham — Nathan Robinson, Commercial Trust Bldg., Phila., Garden type apartment development, 84 bldgs., Washington Lane, city line, etc. **$20,000,000.**

Pa., State College—State College, addnl. dormitories, **$16,000,000.**

Tex., Etter (Dumas P.O.) — Phillips Chemical Co., Bartlesville, Okla., doubling capacity ammonia plant, **$8,500,000,** ammonian nitrate plant, area old cactus Ordnance Works Plant, **$6,500,000.**

Low Bidders & Contracts Awarded

Ore., Portland — Pacific Telephone & Telegraph Co., 730 S.W. Oak St., 6 story long distance bldg., Park and Oak Sts., to Robertson, Hay & Wallace, 1801 S.E. Grand St., **$3,500,000.** Pietro Belluschi, 2040 S.W. Jefferson St., archt.

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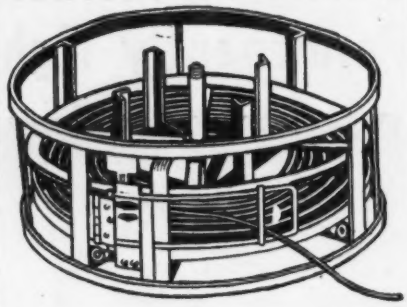

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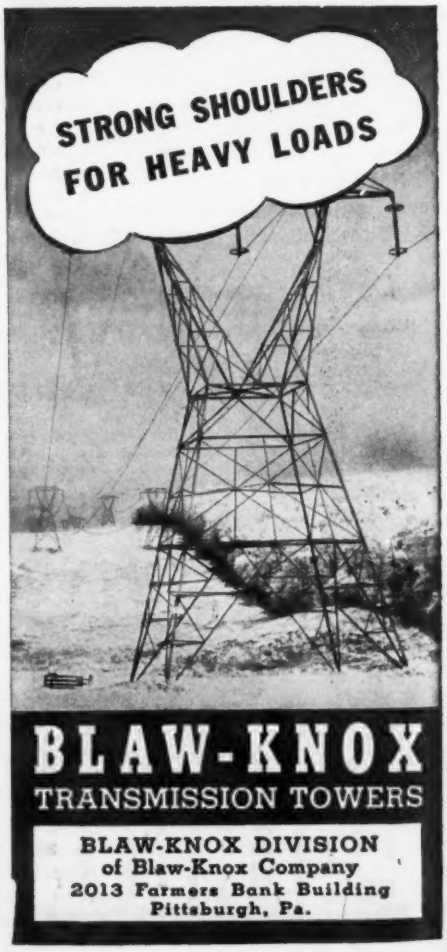

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RECENT RATE CHANGES

PENNSYLVANIA WATER & POWER CO and SAFE HARBOR WATER POWER CORP have been ordered by the state Public Utility Commission to put into effect temporary rates, which will reduce their revenue $1,170,000 annually for wholesale electric power service. The companies were ordered to file with the commission by next Nov 1, to become effective Nov 15, tariffs designed to produce $4,841,000 in a normal year for firm power service within Pennsylvania. Revenues at present are producing $6,011,000 a year, the PUC estimated, or an excess over costs of $1,170,000 annually, on the basis of a normal year. The companies sell electric power at wholesale to five customers, four of them in Pennsylvania. They are Metropolitan Edison, Philadelphia Electric, Pennsylvania Power & Light, and Pennsylvania Railroad. The tariffs to be filed must set $3,371,000 as the annual cost of service in Pennsylvania for firm power to Metropolitan Edison, Philadelphia Electric and PP&L, based on a normal year, the PUC ordered. The annual cost to PRR in the state was fixed at $1,470,000. Costs cover charges for special facilities and demand for energy and the quantity used. In another related order, the PUC denied the motion of the Baltimore company to dismiss the proceeding involving Safe Harbor Water Power. It had permitted the company to intervene for the sole purpose of questioning the commission's jurisdiction over Safe Harbor. The PUC permitted Pennsylvania Water & Power to intervene also as a SHWP shareholder.

SOUTH CAROLINA ELECTRIC & GAS CO has been granted an increase in rates by the state Public Service Commission. The increase was in three principal categories: (1) Increases in electric rates to heavy users, who buy 15,000 kwhr or more a month, to cover increased costs of fuel used in steam generating plants; (2) An increase in electric rates to residential users by abandoning a reduction allowed when bills are paid before a certain date; (3) An increase in manufactured gas rates geared to costs of coal used to make the gas. The increase averaged 8%, Director Walter C. Herbert of the commission's utilities division said. It is designed to allow the utility a 4¼% return on its overall investment.

CITIZENS UTILITIES CO, Nogales, Ariz., has been granted a 10% blanket rate increase by the Arizona Corporation Commission. The utility serves Santa Cruz county in southern Arizona. The company requested the increase to meet higher labor costs.

FLORIDA POWER & LIGHT CO has put into effect new electric rates for residential users in Fort Lauderdale and Daytona Beach and expects to offer the same schedule to West Palm Beach. In each instance the rates will be the same as now prevail in Miami.

COLUMBUS AND SOUTHERN OHIO ELECTRIC Co's receipts from a 4.4% surcharge on electric rates will be impounded in Chillicothe, Ohio, as a result of the city's request for a temporary injunction against collection of the money. The funds will be impounded, pending decision on an objection filed by the city against the increase.

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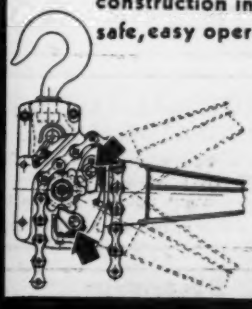

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Subtransmission Economics

(*Continued from page 97*)

Case 3—Where the External Source is a 138-kv Transmission Station and the Area Contains at Least 160 Mva.

Some power will normally be stepped down immediately, to serve the nearby load. Coupling problems, however, should not prevent the economical application of some dual voltage subtransmission. That dual voltage may be 138/34.5 kv for most overhead load areas (with 40 to 80-Mva intermediate stations). However, it can readily be 138/13.8 kv wherever the 13.8-kv cable area-coverage savings more than offset the extra coupling costs of providing firm power 138 kv within or at the mouth of each 20-Mva load area.

This case illustrates conditions where more than two subtransmission voltages can sometimes be justified.

Case 4—Where the External Source is a 69-kv Transmission Station.

Coupling problems are much less severe at 69 kv than at 138 kv. The 69/13.8-kv dual-voltage subtransmission system (using 20-Mva intermediate-station building blocks) represents the general solution. Half-step transformation from 69 to 34.5 kv can seldom be justified. Without modification, this 69/13.8-kv dual voltage system readily supplies overhead load areas, cable load areas, and distribution network needs.

(B) WHERE SUBTRANSMISSION DISTANCE MUST BE COVERED LARGELY BY CABLE.

In large metropolitan areas loads are generally heavy, distances short and intermediate station sites costly. Generation, transmission and subtransmission are inextricably mixed together. Short-circuit bottle-necks handicap the single-voltage 34.5-kv system—and add otherwise unnecessary cost to the 69-kv system, even though breaker manufacturers have achieved 3.5 million IC at 69 kv.

There will be no attempt, therefore, to make limited observations about particular case conditions. It appears however that, particularly in those cable systems which already include some 69 kv, the trend is toward 69/13.8-kv dual-voltage subtransmission with apparatus similar to these 20-Mva building blocks that limit low-side short circuit duty to ½ million kva, regardless of the high-side power concentration.

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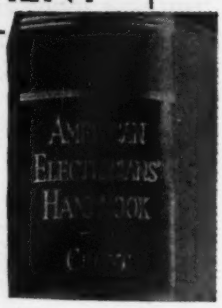

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LETTERS TO THE EDITOR

Use of Walkie-Talkie

To the Editor of ELECTRICAL WORLD:

The letter of Mr. Merritt A. Giles, Supervising Engineer of the Ohio Public Service Co, Elyria, Ohio, published on page 225 of the June 5, 1948 issue, in reference to the use of "walkie-talkie" for line stringing was noted with interest.

I hesitate to disillusion Mr. Giles, but facts are facts. The only similarity is that the same organization, the Gustav Hirsch Organization of Columbus, Ohio was involved. The Hirsch Organization were contractors for the construction of power and communication lines at the U. S. Naval Operating Base, Trinidad, B. W. I., during the past world war period.

The writer was Chief Electrical Engineer for the U. S. Navy, under the Officer-in-Charge of Construction, and was in charge of all power and communication facilities. We not only used "walkie-talkies" but also "handy-talkies" in connection with the installation of power and communication lines. In addition, submarine cables were also laid in the Gulf of Paria during the years of 1942 and 1943.

Mr. Elmer W. Ogden, the field superintendent for the Gustav Hirsch Organization, during the above mentioned period, can verify these statements, if it is desired.

The use of this radio equipment proved to be invaluable, and the writer is using similar equipment in Venezuela at this date.

John J. Carroll
Apartado Postal 1522
Caracas, Venezuela

Utility Ownership

To the Editor of ELECTRICAL WORLD:

Just to keep the record reasonably straight, I have to take exception to your statement (on page 161 of your issue of July 3) that I am "a long standing exponent of public ownership."

I have followed electrical developments fairly closely for over 30 years but have studiously refrained from ever endorsing public ownership as a policy. I have a red apple for you if you find evidence to the contrary.

Ownership as such has never seemed important. The type of operation is what counts, whether applied to properties in public or private ownership.

Morris L. Cooke
Washington, D. C.

SEARCHLIGHT SECTION

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POSITIONS VACANT

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